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SYNTHESIS AND ANALYSIS OF INFORMATION COLLECTED ON THE FISHERY RESOURCES AND HABITAT CONDITIONS OF THE LOWER SANTA YNEZ RIVER: 1993-1996

Prepared in Compliance with Provision 2.C of the 1996 Memorandum of Understanding for Cooperation in Research and Fish Maintenance - Santa Ynez River

Santa Ynez River Consensus Committee
Santa Ynez River Technical Advisory Committee

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PREFACE

During preparation of the 1993 - 1996 Compilation and Synthesis Report, earlier draft copies of the document were circulated to a variety of participants on the Santa Ynez Technical Advisory Committee (TAC), Santa Ynez Consensus Committee, and other interested parties. These draft reports stimulated active discussion among the participants and resulted in a number of constructive recommendations for modifications to data collection activities and the analysis and interpretation of results. Many of the recommendations have been implemented as part of the ongoing program of investigations. Other recommendations will be addressed during preparation of future documentation reports, and in the identification of potential management actions. Although a number of the comments received on the earlier drafts of the 1993 - 1996 report have been incorporated into this document, not all of the recommended changes or modifications could be accommodated. To assist in the preparation of future reports and modifications to the ongoing program of investigation, all of the written comments received on the December 2, 1996 draft Synthesis Report have been included in Appendix C and are considered to be an integral part of this documentation report. We wish to thank all of the individuals who provided review comments and contributed to the development of this documentation report and the overall program of lower Santa Ynez River fisheries investigations.

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SUMMARY OF FINDINGS

A program of cooperative fisheries investigations has been underway on the lower Santa Ynez River, between Bradbury Dam and the Santa Ynez River Lagoon, since 1993. Participants in the program include the U.S. Bureau of Reclamation (USBR), California Department of Fish and Game (CDFandG), U.S. Fish and Wildlife Service (USFWS), various water project operators, and local environmental interest groups. The overall framework for the program of investigations has been established through a "Memorandum of Understanding (MOU) for cooperation in research and fish maintenance" on the Santa Ynez River, downstream of Bradbury Dam.

In order to respond to concerns about providing a reasonable balance in the allocation of Santa Ynez River water between Public Trust Resources and competing consumptive uses, a series of data collection and monitoring studies has been initiated to provide the technical basis for developing management and policy decisions regarding aquatic resources and their associated habitat downstream of the dam. The goal of current and planned studies is to identify reasonable flow and non-flow measures that will improve habitat conditions for fish populations in the Santa Ynez River within the context of competing demands on the Santa Ynez River. The cooperative scientific studies, which began in 1993, are intended to continue and culminate in a program of recommended actions which will meet the objectives of the Santa Ynez River in terms of fisheries and aquatic resources for presentation to the State Water Resources Control Board (SWRCB) in the year 2000.

The fisheries, water quality, and habitat studies initiated in 1993 and continued into 1996, were designed and conducted to provide useful background information on the status of the aquatic resources, and to identify factors influencing the abundance and distribution of various fish species and lifestages. From 1993 to 1996, studies were organized on an annual basis. In 1996, it was identified that development of a long-term study plan to organize these scientific investigations and establish priorities for the investigations would provide an important framework for meeting the objective of developing a recommended plan of actions to the State Water Resources Control Board in the year 2000. The long-term study plan was complemented by a long-term MOU to obviate the necessity of re-negotiating an annual MOU and study plan among the parties.

To assist in the planning process and management of the program of investigations, the 1996 MOU required the compilation, synthesis, and analysis of information collected on the fisheries resources and habitat conditions of the lower Santa Ynez River during the 1993-1996 study period. This report documents the results of the synthesis of technical information characterizing the habitat conditions and fisheries resources of the lower Santa Ynez River, including the mainstem, lagoon, and tributaries collected between 1993 and 1996.

Based upon this synthesis and analysis of data on habitat conditions, water quality, and fisheries within the Santa Ynez River downstream of Bradbury Dam, potential modifications to study elements contained within the long-term study plan are being considered by the SYRTAC. Data and information developed as part of this synthesis report will also be used in preparing a subsequent technical report that identifies a range of potential short- and long-term management actions. The scientific data collected during these studies will be used to evaluate biological benefits, operational constraints, and the feasibility of implementing alternative management actions within the mainstem river, tributaries, and lagoon. The technical report addressing potential management actions is scheduled to be available for preliminary review in June, 1997.

The Santa Ynez River synthesis report was distributed as a preliminary draft for review and comment by participants in the Technical Advisory Committee (SYRTAC) and Consensus Committee. The report was subsequently revised through deletion of the discussion and recommendations regarding modifications to the long-term study plan originally contained in Section 6. Revisions to the long-term study plan are currently being discussed by the Santa Ynez River biological sub-committee and Technical Advisory Committee. As part of the documentation used in preparing the synthesis report, all written comments received on the December 2, 1996 draft have been included as an appendix to the report.

Several key issues were identified during preparation of the synthesis report. These included the fact that the 1993-1996 Santa Ynez River investigations were limited to the mainstem and tributaries downstream of Bradbury Dam. The decision to limit the geographic area encompassed by these studies to the lower river was established in initial discussions by both the Consensus and Technical Advisory Committees during formation of these studies. Habitat exists, however, upstream of Bradbury Dam that provides suitable spawning and rearing areas which is currently inaccessible to anadromous steelhead as a result of the passage barrier created by Bradbury Dam. Management actions for the Santa Ynez River include the potential use of fish ladders and/or trap-and-truck operations to allow migrating steelhead access to these upstream habitat areas. Evaluating the potential benefits of these management actions would require expanding the geographic scope of these investigations to include habitat areas upstream of Bradbury Dam if a feasible mechanisms for upstream and downstream passage can be identified.

The synthesis report focuses attention on seasonal water temperature conditions occurring within the lower Santa Ynez River mainstem and tributaries as a factor potentially limiting habitat suitability for rainbow trout/steelhead. To help the reader interpret the potential biological significance of temperature data collected during the 1993-1996 investigations, thermal criteria were developed from the scientific literature for use as a guideline in evaluating temperature data. The temperature guidelines were founded primarily on results of laboratory and experimental investigations conducted using steelhead from the more northern portion of their geographic distribution (e.g., Oregon, Washington, and British Columbia). The resulting thermal tolerance information developed from northern stocks may underestimate the thermal tolerance of steelhead inhabiting the southern portion of their range, where adaptation to elevated temperatures may have resulted in increased thermal tolerance. Rainbow trout/steelhead were observed in the lower Santa Ynez River and tributaries during the 1993-1996 studies actively foraging and in good health at temperatures expected to result in physiological stress and/or in excess of the incipient lethal threshold. The discrepancy between the thermal tolerance guidelines and the 1993-1996 field observations has not been reconciled. Additional consideration needs to be given to the potential physiological adaptation of southern steelhead to elevated water temperatures as part of the evaluation of current conditions and management alternatives. In addition, further information is also needed to evaluate behavioral adaptations of rainbow trout/steelhead within the Santa Ynez River to microhabitat conditions created by such factors as cool groundwater upwelling and vertical stratification in temperatures occurring within deeper pools.

One of the questions regarding the lower Santa Ynez River is its use as a spawning and rearing area for anadromous steelhead. Anadromous steelhead (those fish spending a portion of their lifecycle in saltwater) and resident rainbow trout (which reside their entire lifecycle in freshwater) cannot be differentiated based on body characteristics. Adult trout were observed within the mainstem and tributaries during the 1993-1996 studies, they successfully spawned, and juveniles were observed rearing in the lower river and tributaries. Data collected as part of these investigations are inconclusive regarding the use of the lower river as habitat by anadromous steelhead. The species exhibits a high degree of plasticity in its lifecycle between resident and anadromous forms, and hence these fish are identified as rainbow trout/steelhead in this synthesis report.

During the 1993-1996 period of these investigations monitoring data were collected on changes in water temperature and dissolved oxygen concentrations resulting from naturally-occurring flows, in addition to managed releases from Bradbury Dam as part of MOU fish reserve account and WR 89-18 flows. In addition to documenting changes in the longitudinal gradient of water temperatures from Bradbury Dam downstream under various flow conditions, changes in water temperatures within pools established during low-flow conditions were measured as surface flows increased. During low-flow periods, particularly in the summer and early fall, algal mats were observed in high density within the lower mainstem Santa Ynez River. Diel measurements of dissolved oxygen showed that levels were high during the late afternoon and low at night and early morning hours. Results of dissolved oxygen measurements are consistent with the hypothesis that algal mats within the mainstem river strongly influence dissolved oxygen concentrations, with oxygen produced by photosynthesis during the daytime and algal metabolism significantly reducing dissolved oxygen concentrations at night. One benefit of flow releases from Bradbury Dam was the removal of mainstem algal accumulations and a corresponding increase in dissolved oxygen concentrations to levels above 7 mg/l which would contribute directly to improvements in habitat quality for fish inhabiting the lower river. Monitoring and analysis of habitat conditions within the lower river in response to releases from Bradbury Dam will be important in evaluating management actions as part of this program.

These and other issues (e.g., suitability of the lagoon as rearing and oversummering habitat for rainbow trout/steelhead, etc.) were identified through development of this synthesis report. Information collected during the 1993-1996 period is not considered to be definitive and should be used as part of the foundation for ongoing efforts designed to characterize existing habitat conditions and aquatic resources and to evaluate the potential benefits of alternative management actions. Data collected through these studies has also been used to identify recommended changes in sampling methods and the scope of investigations being performed. Findings of the synthesis and analysis of data collected during 1993-1996 are summarized below for each of the major elements of the program.

Hydrology

Hydrologic conditions within the Santa Ynez River Basin and tributaries are characterized by:

- High seasonal and inter-annual variability of instream flows and inflow to Cachuma Reservoir, which reflect patterns in seasonal precipitation and storm water runoff;

- During the period from 1991 through 1996, spill from Cachuma Reservoir occurred during the winter-spring of 1993 and during the winter-early summer in 1995 (spill regulated and extended under the seismic operation), in response to periods of high precipitation and inflow to the reservoir. Flow within the mainstem Santa Ynez River as measured at the USGS gauge at Solvang, showed extremely high variability within and between years. Instream flows during the 1993-1996 period ranged from 0 to over 13,000 cfs. A similar pattern of high seasonal and inter-annual variability in Santa Ynez River flows is also apparent at the Narrows, near Lompoc;

- Controlled releases from Bradbury Dam have been made to recharge downstream groundwater basins to meet downstream water rights in accordance with SWRCB decision WR 89-18. Controlled releases were performed during 1991 (June-October), 1992 (July-October), 1994 (July-October), and in 1996 (July-October). Flows during controlled releases were up to approximately 150 cfs;

- Beginning in 1993 the Santa Ynez River MOU established a fish reserve account of 2,000 AF of water within Cachuma Reservoir, which has been managed to (1) maintain and protect fisheries resources downstream of the dam, and (2) conduct specific experimental studies used to evaluate the relationship between instream flow releases and the corresponding response in water quality and/or biological resources at downstream locations. Releases from the fish reserve account (at a rate of 3 to 10 cfs, 6 to 20 AF per day) were made on a seasonal basis in all years since 1993;

- Tributaries to the Santa Ynez River downstream of Bradbury Dam show high variability seasonally and between years, reflecting precipitation and storm water runoff within the basin. Peak seasonal flows within several of the tributaries during the study period exceeded 1,000 cfs. Many of the tributaries are characterized by intermittent flows, having no measurable surface flow during the late spring, summer, and early fall. Several of the creeks, including Salsipuedes and San Miguelito creeks had surface flow (although typically less than 1 cfs) throughout the year during the three year study period;

- A sandbar is present at the confluence between the Santa Ynez River and the Pacific Ocean. The sandbar creates a physical blockage for fish movement into or out of the Santa Ynez River, and also creates a lagoon characterized by a salinity gradient ranging from freshwater at the upstream boundary to full strength sea water at the downstream boundary. Periodically, the sandbar is breached (opened) allowing surface flow from the Santa Ynez River to enter the ocean, and creating an opportunity for both the upstream and downstream passage of migratory fish. Factors contributing to the opening and closure of the Santa Ynez River lagoon include coastal sand transport, tidal action, storm activity, and wave action, in addition to freshwater inflow from the Santa Ynez River and local storm water runoff. Breaching of the lagoon typically occurs during winter months, coincident with storm activity and increased flows within the Santa Ynez River. In the past, the mouth of the lagoon has also been breached mechanically, using a bulldozer, to reduce water elevation within the lagoon, and reduce the risk of localized flooding.

- Based on the 1993-1996 data, it was concluded that seasonal and inter-annual variability of instream flows within the mainstem Santa Ynez River and tributaries represents a major factor influencing habitat quality and availability for various fish species and associated water quality conditions. Instream flows also influence breaching of the sandbar and conditions for upstream and downstream passage of migrating fish (e.g., water depths and velocities) within the Santa Ynez River tributaries and mainstem. The influence of these flow conditions on water quality (temperature, dissolved oxygen, and salinity) habitat characteristics, and the distribution of fish species within the system are discussed.

Water Quality

Water quality monitoring conducted as part of the 1993-1996 investigations primarily focused on water temperature and dissolved oxygen concentrations. Monitoring was performed within Lake Cachuma, the mainstem Santa Ynez River, selected tributaries, and the lagoon. In addition, salinity was monitored within the lagoon. Nutrient monitoring (nitrogen and phosphorous) has not been a part of the water quality investigations. As a result of the extensive algal growth observed in the river, it has been recommended that water quality monitoring be expanded to include nutrients, and possibly other constituents. Water quality data, including nutrients, is available from other investigators and should be compiled and incorporated as part of the information available to the Santa Ynez River fisheries investigations.

Observations and results of the 1993-1996 water quality monitoring program are briefly summarized below.

Mainstem Water Temperature

Results of water temperature monitoring on the Santa Ynez River have generally shown:

- Cachuma Reservoir becomes thermally stratified during the summer and fall and destratified (relatively uniform temperatures from the surface to the bottom) during the winter. During the period of stratification water temperature and dissolved oxygen concentrations are greatest in the upper part of the water column (epilimnion), with the coolest water temperatures and dissolved oxygen concentrations decreasing below 2 mg/l within the lower part of the water column (hypolimnion). After fall turnover, water temperature and dissolved oxygen concentrations (6-8 mg/l) were relatively consistent throughout the water column.

- Water temperature follows a general seasonal pattern with increasing temperatures during the spring and summer and decreasing temperatures during the fall and winter, coincident with the seasonal pattern in air temperature;

- Water temperature, particularly during summer, is lowest near Bradbury Dam, with a longitudinal gradient of increasing temperature moving downstream;

- Daily variation in water temperature, particularly during the summer, is generally lowest near Bradbury Dam, with a longitudinal gradient of increasing daily variation in water temperature at locations further downstream;

- Seasonal patterns of water temperature within the Santa Ynez River Lagoon are typically cooler, particularly during the summer, than water temperatures occurring at locations further upstream, with the exception of those immediately below Bradbury Dam;

- Information on thermal tolerance and the physiological response of rainbow trout/steelhead to elevated water temperatures (e.g., stress, reduced growth rates, etc.) are available primarily for steelhead stocks from the northern part of their geographic distribution (Oregon, Washington, and British Columbia). It has been hypothesized, however, that thermal tolerance of northern populations may be lower than the actual tolerance for stocks inhabiting the southern end of their geographic distribution. No definitive data are available on the thermal tolerance for southern steelhead stocks for use in developing thermal tolerance indices. Thermal tolerance criteria (frequency of average daily temperatures greater than 20 C, and frequency of maximum daily temperatures greater than 25 C) should, therefore, not be used as absolute thermal thresholds, but rather represent general guidelines for assessing the biological significance of water temperature conditions monitored during the 1993-1996 period of these investigations;

- Evaluation of average daily and maximum daily water temperatures, with respect to thermal tolerance indices for rainbow trout/steelhead, showed water temperatures are within acceptable ranges at all locations downstream of Bradbury Dam during the late fall, winter, and early spring;

- Water temperatures at a number of mainstem monitoring sites exceeded temperature criteria (average daily water temperature greater than 20 C, or maximum daily temperature greater than 25 C) for rainbow trout/steelhead during the summer;

- The frequency and magnitude of daily temperatures that exceed criteria for rainbow trout/steelhead increased as a function of distance downstream from Bradbury Dam, with the exception of temperature conditions occurring within the lagoon;

- Results of temperature monitoring during the 1996 WR 89-18 releases showed that water temperatures increased rapidly, resulting in potentially adverse water temperatures for rainbow trout/steelhead at locations 3.4 miles and further downstream of the dam, despite instream flow releases of 50 to 135 cfs.

- Several temperature models have been developed for the lower Santa Ynez River based upon predicted environmental conditions and the use of empirical data in statistical regression analyses. Results of these models are generally consistent in describing the longitudinal gradient in water temperatures occurring at locations downstream of Bradbury Dam.

- Maximum water temperatures recorded from surface thermographs on one or more days during the summer months exceeded the estimated incipient lethal threshold (>25 C) at the Refugio Habitat Unit X (3.4 miles downstream of Bradbury Dam), and at all habitat units monitored further downstream, with the exception of the lagoon. Except for Alisal Habitat Unit 48, bottom thermographs in pools never recorded temperatures exceeding 24 C.

- Based upon the general temperature guidelines, temperatures monitored during 1995 and 1996 would be expected to result in physiological stress and/or mortality for rainbow trout/steelhead, thereby making summer habitat conditions unacceptable at a number of the locations monitored on the mainstem Santa Ynez River, however trout continued to occupy several locations, and appeared to remain in good health and increased in size;

- The discrepancy between the thermal tolerance criteria used in the preliminary assessment needs to be reconciled with field observations of the occurrence of fish within the mainstem river and tributaries. Further investigations should focus on such factors as microhabitat conditions (e.g., localized cool groundwater upwelling) and the potential that southern rainbow trout/steelhead stocks inhabiting the Santa Ynez River have greater thermal tolerance than stocks used in developing the temperature criteria. A more comprehensive evaluation of the significance of water temperature conditions on the mainstem Santa Ynez River and tributaries with regard to the geographic location, areal extent, and seasonal characteristics of habitat suitability based on water temperature conditions is included as part of the long-term plan;

- In summer, when flows are low (or at low flow releases), localized cool groundwater upwelling may provide acceptable conditions for rainbow trout/steelhead to successfully inhabit pools and other areas downstream of Bradbury Dam. The number of rainbow trout/steelhead inhabiting the Alisal reach remained relatively constant between August (34 fish) and December, 1995 (31 fish), despite elevated water temperatures during the later summer. The extent of localized groundwater downstream of Bradbury Dam and the percentage of pool habitats affected by cool groundwater has not been quantified. Temperature monitoring studies identified in the long-term study plan will provide additional information on seasonal temperature conditions within the lower river; and

- Data gaps and failure of temperature monitoring instruments at a number of the locations resulted in incomplete temperature monitoring records.

Mainstem Dissolved Oxygen

Results of dissolved oxygen monitoring within the mainstem Santa Ynez River have generally shown:

- Extensive algal production between late spring and early fall contributes to substantial diel variation in dissolved oxygen concentrations and may adversely affect habitat quality for resident fish;

- Dissolved oxygen concentrations at night (measured during pre-dawn surveys) showed dissolved oxygen concentrations within many habitats ranging from 1 to 3 mg/l;

- Low diel dissolved oxygen concentrations, measured at several habitat units, would be expected to result in severe physiological stress and/or acute mortality to many fish species (less than 2 mg/l);

- A vertical gradient in dissolved oxygen concentrations was observed at several deeper pool habitat units, with daytime dissolved oxygen concentrations being greatest near the surface, with a marked decline in dissolved oxygen near the bottom. A similar vertical gradient in water temperature was observed at many of these locations, with highest water temperatures near the surface, and lowest water temperatures near the bottom. These results are consistent with the hypothesis that vertical stratification becomes established within deeper pool habitats in the absence of significant flow. Vertical stratification within these habitats during the summer would present a potential conflict in habitat selection by species such as rainbow trout/steelhead in which areas of the habitat having sufficient dissolved oxygen concentrations may also have elevated, and potentially stressful, water temperature conditions;

- Rooted aquatic vegetation was abundant after high flows in 1995 removed accumulated filamentous algal mats;

- Early morning dissolved oxygen concentrations during the fall were substantially higher than those during the summer, coincident with a seasonal decline in algal cover and decreased temperatures; and

- River flow provided by the 1996 WR 89-18 releases was sufficient to remove much of the algae from pool habitats and create sufficient turbulence and mixing to sustain higher dissolved oxygen concentrations (7 mg/l) during the critical morning hours at any of the flows tested. The reduction in algal accumulations within the mainstem Santa Ynez River resulting from flow releases from Bradbury Dam directly improved habitat conditions for fish downstream of the dam.

Santa Ynez River Lagoon

Results of water quality monitoring within the Santa Ynez River Lagoon have generally shown:

- No substantial differences were observed in water quality measurements (water temperature, dissolved oxygen, and salinity) across transects within the lagoon, however, when the lagoon was both open and closed, water quality differences were observed between upstream and downstream monitoring locations;

- The lagoon water depth more than doubled at all sampling locations in 1995 after the lagoon breach closed. Vertical gradients were observed in water temperature, dissolved oxygen, and salinity within deeper areas of the lagoon during periods when the lagoon breach was closed. Vertical stratification in water quality parameters varied substantially between locations and survey periods;

- Average daily and maximum daily water temperatures within the lagoon during the summer were consistently lower than water temperatures measured at upstream monitoring locations, with the exception of locations immediately downstream from Bradbury Dam;

- Dissolved oxygen concentrations were generally greater than 5 mg/l in the upper three quarters of the water column during months when stratification within the lagoon had developed. The lower one quarter of the water column had dissolved oxygen levels less than 4 mg/l, with concentrations less than 1 mg/l developing at the bottom one foot at most sites;

- Salinity levels within the lagoon followed a consistent longitudinal pattern, with salinity near brackish/full strength sea water at Ocean Park, decreasing to freshwater at the upstream location;

- Salinity level varied at each site between months, reflecting seasonal variation in the balance between freshwater inflow and tidal influence. Higher salinity concentrations were observed at high tide at all three sites, particularly when the lagoon breach was open.

Tributary Water Temperature

Water temperature monitoring within various tributaries to the lower Santa Ynez River has shown:

Hilton Creek

- Summer (June-August) water temperatures in 1995 within Hilton Creek (250 feet upstream of the confluence with the Santa Ynez River) showed maximum daily water temperatures ranging from 16.4 to 26.3 C. Young-of-the-year rainbow trout/steelhead were observed to be generally healthy and actively feeding at temperatures up to 25.8 C within Hilton Creek. The discrepancy between the observation of young-of-year rainbow trout/steelhead inhabiting Hilton Creek when measured water temperatures were greater than 25 C, used as the incipient lethal threshold for these preliminary analyses, supports the general hypothesis that southern stocks may have a greater thermal tolerance than more northerly populations upon which the general temperature indices used in this analysis were developed. Young-of-year rainbow trout/steelhead were observed within Hilton Creek only until July, 1995. After July surface flow within the creek was lost and the creek dewatered. Numerous young-of-year rainbow trout/steelhead were observed to have died;

- A deeper water pool (upper Chute Pool) exists within Hilton Creek immediately downstream of the potential fish passage barrier, located approximately 1,200 feet upstream of the confluence, which represents an area where adult rainbow trout/steelhead accumulate, and/or juvenile rearing may occur. Summer water temperatures within the pool were substantially lower than temperatures measured within Hilton Creek further downstream. Water temperatures within the pool may be suitable through at least August to provide habitat for rainbow trout/steelhead, although the pool would be physically isolated from fish movement either upstream or downstream during at least a portion of the year; and

- The deeper water pool on Hilton Creek was observed to persist into the summer during 1995, a high precipitation year. This pool did not persist throughout 1995, and was not observed to persist through the summer of 1996. Seasonal patterns in surface flows and the persistence of the deeper pool within Hilton Creek varies among years depending upon precipitation and runoff within the watershed.

Nojoqui Creek

- Average daily and maximum daily water temperatures within Nojoqui Creek exceeded the temperature criteria during the summer of 1995 and 1996. Water temperatures exceeded the potential incipient lethal threshold (25 C) during June - August, 1995, and June, 1996;

Salsipuedes Creek

- Upper Salsipuedes Creek is characterized by having an intact riparian corridor with abundant canopy within which water temperatures were substantially cooler than those observed in either El Jaro or lower Salsipuedes Creek. The streambed is wider and the canopy less abundant in the lower section of Salsipuedes Creek, which may also contribute to the higher observed water temperatures within this reach of the tributary. Water temperatures did not exceed 25 C in either 1995 or 1996. At no time did average daily temperatures exceed 20 C;

El Jaro Creek

- Inflow during the summer from El Jaro Creek contributed to substantially higher average daily and maximum daily water temperatures within lower Salsipuedes Creek. Average daily and maximum daily temperatures within Salsipuedes Creek downstream of the confluence with El Jaro Creek exceeded the 20 and 25 C temperature criteria in both 1995 and 1996. Maximum daily temperatures exceeded 27 C on occasion in both 1995 and 1996, representing conditions potentially above the incipient lethal level for rainbow trout/steelhead;

- Water temperature monitoring data during the summer months from El Jaro Creek confirmed higher average daily and maximum daily water temperatures than those observed within upper Salsipuedes Creek. The relatively high and sustained average daily temperatures during the summer, in combination with maximum daily temperatures over 26 C during both 1995 and 1996 within El Jaro Creek are expected to contribute to physiological stress, reduced growth rates, and potentially incipient lethal conditions for rainbow trout/steelhead; and

- Rainbow trout/steelhead have been observed during snorkeling surveys in numerous habitat units in El Jaro Creek, including young-of-year and size classes up to approximately 8-10 inches (observed during the summer, 1996). As noted above, additional information needs to be developed as part of the long-term study plan, regarding microhabitat selection in response to water temperature conditions and the biological significance of water temperatures observed in tributaries such as El Jaro Creek on the health of individuals, potential mortality, and population abundance, particularly during summer conditions when temperatures within these tributaries are elevated. Microhabitat selection of rainbow trout/steelhead reflects a behavioral adaptation to water temperature conditions, and may also reflect a physiological adaptation of southern stocks to greater tolerance to elevated water temperature conditions occurring within this part of their geographic distribution.

Habitat Characteristics

Fish habitat in the Santa Ynez River mainstem has been surveyed extensively upstream of Highway 101 in Buellton and in a section near Lompoc. Mesohabitat characteristics (pool, riffle, run) have been described in that section of the river. Habitat conditions in other sections of the mainstem have not been documented. The level of detail and area of coverage for habitat surveys in the tributaries have been significantly less than that in the mainstem. Results of habitat surveys on the mainstem Santa Ynez River and tributaries have shown:

- The mainstem, in surveyed reaches, contains a generally diverse mix of habitat types during periods when the river is flowing but the utility of riffle and run habitats is limited during low flow periods. Pool habitat exists even at low flow, but utility of pool habitats may be limited for rainbow trout/steelhead by lack of flow, elevated summer water temperature and low dissolved oxygen levels.

- Riparian vegetation is poorly developed in the mainstem and in most areas does not provide significant shade. Riparian vegetation in the tributaries has not been surveyed at a sufficient level of detail to compare to the mainstem, however observations indicate portions of some tributaries are well shaded.

- Instream vegetation in the mainstem in the form of algal mats can be extensive during summer months. Algae is not usually extensive in the reach immediately downstream of Bradbury Dam (except in some pools), but can dominate the aquatic habitat in the Refugio and Alisal reaches during summer low flow conditions. WR 89-18 releases appeared to reduce or eliminate algal mats. Reductions in algal biomass accumulation within the mainstem Santa Ynez River as a direct consequence of releases from Bradbury Dam resulted in improved habitat conditions (e.g., increased dissolved oxygen concentrations) for fish resident in these areas;

- Pools, particularly deep pools, provide habitat for juvenile and older age classes of rainbow trout/steelhead, largemouth bass and sunfish. During low flow conditions these may be the only aquatic habitat available. Pools in the lower reaches can be thermally stratified during periods when there is little or no flow with relatively cool water at the bottom of deeper pools (thermal stratification can occur in pools as shallow as 3-4 feet). Pools in the Highway 154, Refugio, and Alisal reaches (up to 9.5 miles downstream of Bradbury Dam) held trout greater than 6 inches in length throughout the summers of 1995 and 1996 under conditions of little or no surface streamflow. There is some uncertainty about the distribution of pool habitat since surveys conducted in 1994 and 1995 gave different results, possibly due to differences in reaches surveyed, changes due to high flows in the intervening winter, or both.

- Substrate in the form of gravel of suitable size for spawning rainbow trout/steelhead is found in all the surveyed reaches but its utility is dependent on the volume of streamflow. Quality of spawning gravel in the Lompoc reach was poor due to accumulations of fine sediments. The areal extent of spawning gravel in the mainstem has not been quantified. Entrix (1995) has attempted to assess the relationship of river flow to the availability of spawning habitat for rainbow trout/steelhead using the IFIM methodology. A discussion of that analysis is presented in the Cachuma Contract Renewal Fish Resources Technical Report (Entrix, 1995).

- The only passage barriers found in the mainstem were due to shallow conditions during low flows, and some beaver dams at low to moderate flows. Alisal Creek has been blocked just upstream of the mouth by a concrete structure, which subsequently washed away during January, 1995. Although not part of the 1993-1996 investigations, it is possible that adult steelhead that immigrate into the Santa Ynez River during periods of high winter flows may be trapped within the river by low-flow passage barriers and therefore may oversummer within the river before subsequent high flow conditions occur that would allow these adult fish to successfully complete their downstream migration to the ocean. Future evaluation of mainstem fish passage should include consideration of the seasonal timing and hydrologic conditions for both upstream and downstream migration of adult fish;

- Two cascades below bridges in Salsipuedes Creek may hinder migration of rainbow trout/steelhead at lower flows, particularly smaller resident fish. SYRTAC and USFWS biologists believe these barriers are passable only during high flows. A bridge on El Jaro Creek is also believed to be a passage impediment.

Fishery Resources

Results of fishery surveys on the mainstem Santa Ynez River and tributaries have shown:

- The Santa Ynez River downstream of Bradbury Dam supports fluctuating and transient populations of fish. The most abundant species are those that have tolerance for widely fluctuating conditions of streamflow, temperature, and dissolved oxygen. The fish community in larger, deeper pools was dominated by introduced species, including largemouth and smallmouth bass, green sunfish, bluegill, redear sunfish, channel catfish and bullheads, species preferring warm, non-flowing aquatic habitats. Largemouth bass, in particular, reproduce successfully and are abundant in the river below Bradbury Dam. Bass fry were observed in the long pool in May 1994 and from August through October in 1995. All of the native species reported for the river in the 1940s are still present. The observations of adult and larval Pacific lamprey indicates that, although this species is not abundant, conditions exist that allow for completion of its anadromous life cycle.

- In visual surveys conducted in the Santa Ynez River mainstem in 1995, rainbow trout/steelhead were most abundant in the Highway 154 reach and less abundant in the Refugio reach and Alisal reach. A few surveys in the tributaries indicate that self sustaining rainbow trout/steelhead populations may be abundant in some areas. It is not known whether these were resident or anadromous populations. Surveys have not been conducted in a way that allows easy comparison of population density in the tributaries to that in the mainstem.

- Rainbow trout/steelhead juveniles survived, apparently in healthy condition, in isolated pools in the Santa Ynez River mainstem through the summer and into the fall of 1995 and 1996 in spite of water temperature and dissolved oxygen conditions that exceeded standard tolerance criteria for the species. If trout currently inhabiting the Santa Ynez River or its tributaries are of native southern steelhead stocks they may be adapted to warmer temperatures than more northern stocks. Survival in these habitats may have been related to upwelling of cool water under low flow conditions, the presence of extensive riparian canopy, reduced abundance of floating algal mats, lack of large predatory fish (largemouth bass), or a combination of these factors. During 1996 trout also persisted in the mainstem after initiation of WR 89-18 releases and loss of thermal stratification in pools.

- Young-of-year rainbow trout/steelhead were found in the mainstem only in the Highway 154 reach. These are thought to have originated in Hilton Creek since numerous young-of-year were seen in Hilton Creek early in the season. Spawning in the mainstem downstream of Bradbury Dam was not observed but can not be ruled out. Extensive surveys for spawning fish have not been routinely conducted.

- The tributaries support populations of primarily native species including rainbow trout/steelhead, stickleback, and sculpin though the introduced arroyo chub is also widespread.

- With the notable exception of Hilton Creek, systematic and extensive surveys for spawning rainbow trout/steelhead, or young-of-year have not been conducted in the tributaries. Although extensive spawning has been documented in Hilton Creek, it has also been the area where surveys have been most routine and persistent.

- Salsipuedes and El Jaro creeks support a reproducing population of rainbow trout/steelhead based on the presence of a range of age classes, including young-of-year. The fish appeared healthy, though they were not abundant. Rainbow trout/steelhead redds have also been seen in both Salsipuedes and El Jaro creeks. The capture of juvenile rainbow trout/steelhead exhibiting evidence of smoltification in both 1995 and 1996 indicates the presence of anadromous traits within the population.

- Fish habitat and fish population surveys in the tributaries have not been extensive or routine but, based on the presence of a range of age classes including young-of-year, self-sustaining populations of rainbow trout/steelhead have also been observed in the headwaters of Alisal Creek and a tributary of Quiota Creek. No evidence of rainbow trout/steelhead has been found in the lower sections of Nojoqui Creek but good spawning and rearing habitat exists there. Spawning and the production of young-of-year rainbow trout/steelhead has occurred in Hilton Creek in some years. Lower reaches of Hilton Creek do not provide viable rearing habitat since the stream is frequently dry during summer months. A potential passage barrier a short distance upstream from the mouth may limit or preclude access to the upper reaches of the stream. Surveys of the abundance and species composition of fish inhabiting the upper reaches of Hilton Creek were not conducted as part of the 1993-1996 investigation. Although fisheries surveys focused on the reach below the existing Hilton Creek passage barrier, general observations indicate that the upper reaches of the creek offer potentially suitable habitat. As part of these investigations, we recommend that additional biological and habitat surveys be performed to identify areas within the tributaries that offer habitat potential in the event that a passage barrier could be removed as part of the management actions being developed through this program. Numerous young-of-year rainbow trout/steelhead were seen in San Miguelito Creek in 1996.

1.0 INTRODUCTION

Since 1993, a program of cooperative fisheries investigations has been underway on the lower Santa Ynez River, between Bradbury Dam and the Santa Ynez River Lagoon (Figure 1-1). Participants in the program include the U.S. Bureau of Reclamation (USBR), California Department of Fish and Game (CDFandG), U.S. Fish and Wildlife Service (USFWS), various water project operators, and local environmental interest groups. The overall framework for the program of investigations has been established through a "Memorandum of Understanding (MOU) for Cooperation in Research and Fish Maintenance" on the Santa Ynez River, downstream of Bradbury Dam. The MOU established a Santa Ynez River Technical Advisory Committee (SYRTAC) with the ultimate goal of "developing recommendations for long-term fisheries management, projects, and operation" in the lower river. The MOU and SYRTAC were established in response to State Water Resources Control Board (SWRCB) actions dealing with Bradbury Dam and the lower Santa Ynez River that culminated in the SWRCB requesting flow recommendations for maintenance of Public Trust Resources in the lower river. The MOU and SYRTAC were also established to broaden the scope of management options to protect Public Trust Resources within the lower river, to attempt to accommodate the needs of all interested parties, and ultimately to develop mutually acceptable management options to balance competing needs for water and other resources associated with the Santa Ynez River. The waters of the Santa Ynez River have many uses, including maintenance of Public Trust Resources, both within Lake Cachuma and downstream of Bradbury Dam, as well as consumptive urban and agricultural uses within the Santa Ynez Valley and along the coastal plain encompassing the City of Santa Barbara. Water management, urban encroachment, agriculture, flood control, and gravel mining have all raised concerns over the condition of the Public Trust Resources of the lower river. The existence of these activities has also raised concern about the economic and social impacts of efforts to significantly alter the existing flow regime of the river.

In order to respond to concerns about providing a reasonable balance in the allocation of Santa Ynez River water between Public Trust Resources and competing consumptive uses, as well as between Public Trust Resources within Lake Cachuma and Public Trust Resources downstream of Bradbury Dam, a series of monitoring studies was initiated to provide the technical basis for developing management and policy decisions regarding aquatic resources and their associated habitat downstream of the dam. The overall goal of these studies has been to identify reasonable flow and non-flow measures that will improve habitat conditions for fish populations in the Santa Ynez River within the context of overall management objectives and competing demands on the Santa Ynez River. Specific objectives of the scientific studies performed on the river between 1993 and 1996 (and continuing) are to develop baseline and technical information regarding:

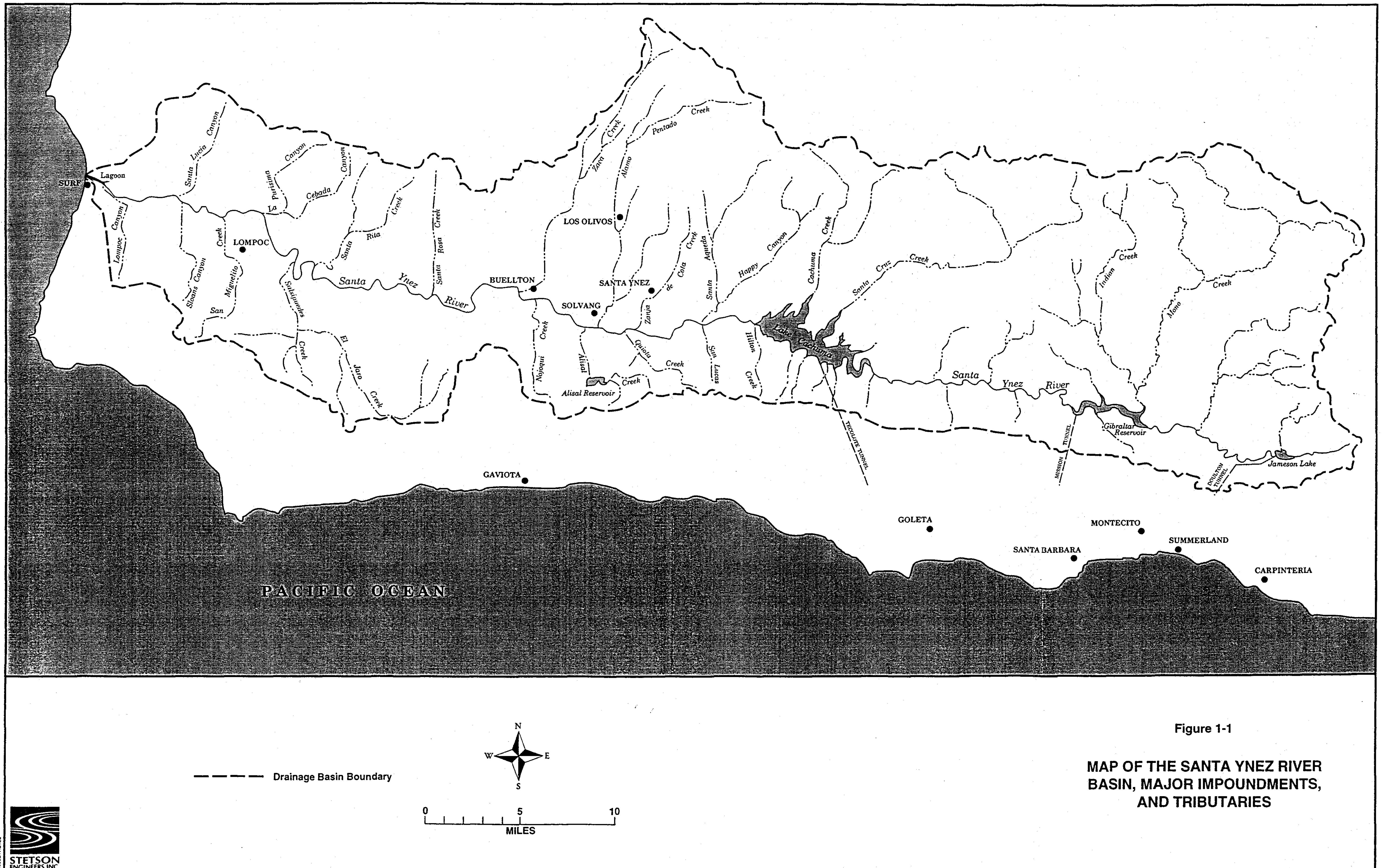


Figure 1-1

MAP OF THE SANTA YNEZ RIVER BASIN, MAJOR IMPOUNDMENTS, AND TRIBUTARIES

1. The diversity, abundance, and condition of existing Public Trust fishery resources within the lower river;

2. Conditions, including both habitat quality and quantity and water quality and quantity, which may limit the diversity, abundance, or condition of Public Trust fisheries resources within the lower river;

3. Alternative flow regimes for the Cachuma Project which could be expected to change the conditions that currently act to limit the diversity, abundance, or condition of Public Trust fisheries resources within the lower river; and

4. Non-flow measures which could be undertaken to change existing conditions that act to limit the diversity, abundance, or condition of Public Trust fishery resources within the lower river.

Data collected from baseline and long-term studies (Appendix A) are intended to be used to identify and evaluate potential alternative management actions that will be based, in part, on the following objectives:

- Improve habitat conditions to maintain fish populations in good condition;

- Protect, maintain, and improve habitat conditions for species listed under the State and Federal Endangered Species Acts, or identified as California Species of Special Concern;

- Improve the availability and suitability of stream corridor and channel habitat for a diversity of species of fish and wildlife.

Using data developed as part of this cooperative program of investigations, alternative management recommendations will ultimately be developed and evaluated in context with other management objectives for the river. The comparative feasibility of various alternative actions in achieving these management objectives will be evaluated with respect to the following criteria:

- The proposed management action has a reasonable probability of achieving the desired benefit;

- The proposed management action can be reasonably implemented considering the constraints imposed by natural hydrologic conditions.

The cooperative scientific studies, which began in 1993, are intended to continue and to culminate in a program of recommended actions which will meet the overall objectives of the Santa Ynez River in terms of fisheries and aquatic resources for presentation to the State Water Resources Control Board in the year 2000. The fisheries, water quality, and habitat studies which were initiated in 1993, and continued into 1996, have been designed and conducted to provide useful background information on the status of the aquatic resources, and to identify factors influencing the abundance and distribution of various fish species and life stages. Descriptions of the study elements and data developed as part of this program have been documented by SYRTAC (1993), Engblom (1994, 1995), and Entrix (1995). Although the primary species of interest in developing these studies has been rainbow trout/steelhead, all of the fish species comprising the Santa Ynez River aquatic community downstream of Bradbury Dam (Table 1-1) have been included as part of the studies.

From 1993 to 1996 studies were organized on an annual basis. In 1996, it was identified that development of a long-term study plan to organize these scientific investigations and establish priorities for the investigations would provide an important framework for meeting the overall objectives of developing and providing a recommended plan of actions to the State Water Resources Control Board in the year 2000. In an iterative process which included the Consensus Committee, the Technical Advisory Committee, and the Biology Subcommittee, a long-term study plan was developed and adopted as Attachment A of the 1996 MOU (Appendix A).

To assist in the overall planning process and management of the program of investigations, the 1996 MOU required the compilation, synthesis, and analysis of information collected on the fisheries resources and habitat conditions of the lower Santa Ynez River during the 1993-1996 study period. The following report documents the results of the synthesis and evaluation of technical information characterizing the habitat conditions and fisheries resources of the lower Santa Ynez River, including the mainstem, lagoon, and tributaries collected between 1993 and 1996. The results of the synthesis are also used to identify recommended modifications to the 1996 MOU long-term study plan, including the introduction of new study elements, expansion or contraction of the current study elements, or the elimination of elements from the long-term study plan. A second technical report is also being prepared, based upon data collected during the 1993-1996 studies, which will help identify potential management actions for consideration on the lower Santa Ynez River, and determine the adequacy of current information for evaluating the limitations, constraints, and feasibility of implementing potential actions, in addition to evaluating anticipated biological benefits. The report identifying potential long-term management actions and opportunities to be evaluated in future investigations is scheduled to be completed and available for review in July, 1997.

The July, 1997 report is intended to serve as a preliminary identification of potential management actions to help guide further data collection activities and analyses within the overall context of the long-term plan (Job 10). The July, 1997 report will serve to provide an initial identification of potential management actions which will be expanded and modified to include other potential actions and ideas for improving fisheries habitat as they are developed through the ongoing process of data collection and evaluation of the feasibility of various options. The evaluation and exploration of various options, in

Table 1-1. Common and scientific names and status (native (N) or introduced (I)) of fish collected and/or observed in the Santa Ynez River basin streams and reservoirs (Source: Entrix, 1995).

Common Name	Scientific Name	Status	Location
Rainbow/steelhead trout	*Oncorhynchus mykiss*	N	RATCL
Threespine Stickleback	*Gasterosteus aculeatus*	N	RATCL
Prickly sculpin	*Cottus asper*	N	RATCL
Pacific lamprey	*Lampetra tridentata*	N	R
Arroyo chub	*Gila orcutti*	I[1]	RATCL
Fathead minnow	*Pimephales promelas*	I	RT
Mosquitofish	*Gambusia affinis*	I	ACL
Smallmouth bass	*Micropterus dolomieui*	I	RACL
Largemouth bass	*Micropterus salmoides*	I	RATC
Bluegill	*Lepomis macrochirus*	I	RAC
Green sunfish	*Lepomis cyanellus*	I	RATC
Redear sunfish	*Lepomis microlophus*	I	RC
Black crappie	*Pomoxis nigromaculatus*	I	C
White crappie	*Pomoxis annularis*	I	C
Channel catfish	*Ictalurus punctatus.*	I	RAC
Black bullhead	*Ameiurus melas*	I	RAC
Threadfin shad	*Dorosoma petenense*	I	C
Goldfish	*Carassius auratus*	I	RAC
Carp	*Cyprinus carpio*	I	RAC
Tidewater goby	*Eucyclogobius newberryi*	N[2]	L
Pacific herring	*Clupea harengeus*	N	L
Topsmelt	*Atherinops affinis*	N	L
Shiner Perch	*Cymatogaster aggregata*	N	L
Staghorn sculpin	*Leptocottus armatus*	N	L
Starry flounder	*Platichthys stellatus*	N	L
Brown trout	*Salmo trutta*	I	-[3]
Brook trout	*Salvelinus fontinalis*	I	-[3]
Walleye	*Stizostedion vitreum*	I	-[3]

[1]California species of special concern.
[2]Endangered species under the ESA.
[3]Introductions of these species were unsuccessful according to CDFG Region 5 data.
R = Santa Ynez River below Bradbury Dam
A = Santa Ynez River above Lake Cachuma
T = Tributary Streams
C = Lake Cachuma
L = Santa Ynez River lagoon

addition to identification of new or innovative approaches to addressing Santa Ynez River fisheries issues, will continue to evolve over the next several years of the program and will not be limited to actions discussed in the July, 1997 report. The ultimate objective of these analyses and deliberations will be to identify a range of actions for presentation to the State Water Resources Control Board in hearings scheduled for the year 2000. The July, 1997 report is intended to only be the initial step in the process of identifying and evaluating alternative actions, and to serve as a platform for stimulating the discussion of alternatives and the data necessary to evaluate potential biological benefits and feasibility within the overall context provided by the Technical Advisory Committee. The report will also serve as an important tool to check the adequacy of current study elements and data collection protocols to supply information needed to evaluate alternative actions.

The synthesis and analysis of information collected between 1993 and 1996 on the fisheries resources and habitat conditions of the lower Santa Ynez River includes a summary of hydrologic conditions and reservoir operations for Bradbury Dam on the Santa Ynez River, and major tributaries, which is summarized in Section 2. Section 3 presents a summary of water quality monitoring data, focusing on results of water temperature, dissolved oxygen, and salinity measurements, collected at various locations including Lake Cachuma, along the longitudinal gradient of the mainstem Santa Ynez River from Bradbury Dam downstream to the lagoon, and within major tributaries. Results of stream corridor and channel habitat mapping surveys within the mainstem river, lagoon, and tributaries are presented in Section 4. Fisheries resources observed from locations downstream of Bradbury Dam, including major tributaries and the lagoon, are discussed in Section 5.

2.0 SANTA YNEZ RIVER HYDROLOGY

The following section presents a brief overview of Santa Ynez River hydrologic conditions which occurred during the period from October, 1990 through August, 1996. The major features of the Santa Ynez River drainage, including impoundments and major tributaries are shown in Figure 2-1. Data on Santa Ynez River hydrology and Cachuma Project operations were compiled from U.S. Bureau of Reclamation and U.S. Geological Survey (USGS) monitoring data by Ali Shahroody (Stetson Engineers, Inc.). Detailed records on daily hydrologic conditions and Cachuma project operations are presented in tabular format in Appendix B.

2.1 Precipitation and Lake Cachuma Inflow

Inflows to Cachuma Reservoir, and the instream hydrology within both the mainstem Santa Ynez River and tributaries, are determined by annual and seasonal patterns in rainfall precipitation. The seasonal and inter-annual pattern in total monthly rainfall, measured at Cachuma Reservoir, is shown in Figure 2-2. Rainfall primarily occurs during the winter (December-March), and to a lesser extent during the fall (October-November), and spring (April-June). The resulting storm water runoff is reflected in the seasonal pattern and inter-annual variability of inflow to Cachuma Reservoir (Figure 2-3).

During the 1993-1996 period of these fisheries investigations, 1993 and 1995 represent years of high inflow to Cachuma Reservoir, while 1994 and 1996 reflect years with low reservoir inflow (Figure 2-3). One of the primary advantages of conducting a long-term investigation of fisheries resources, habitat conditions, and water quality conditions within the Santa Ynez River is the ability to monitor and evaluate changes in biological resources in response to a variety of water-year-types, including both wet and dry-year hydrologic conditions.

2.2 Lake Cachuma Elevation, and Storage

Average monthly water surface elevation and reservoir storage volume within Lake Cachuma is shown in Figure 2-4. During the mid- to late-1980's, and extending into the early 1990's, the Santa Ynez River basin experienced a series of drought conditions, resulting in depletion of water storage within Lake Cachuma. Although not monitored as part of this investigation, it is likely that the succession of low-flow drought years contributed to stressed environmental conditions and the loss of suitable aquatic habitat for fish within the mainstem Santa Ynez River below Bradbury Dam, in addition to major tributaries within the drainage.

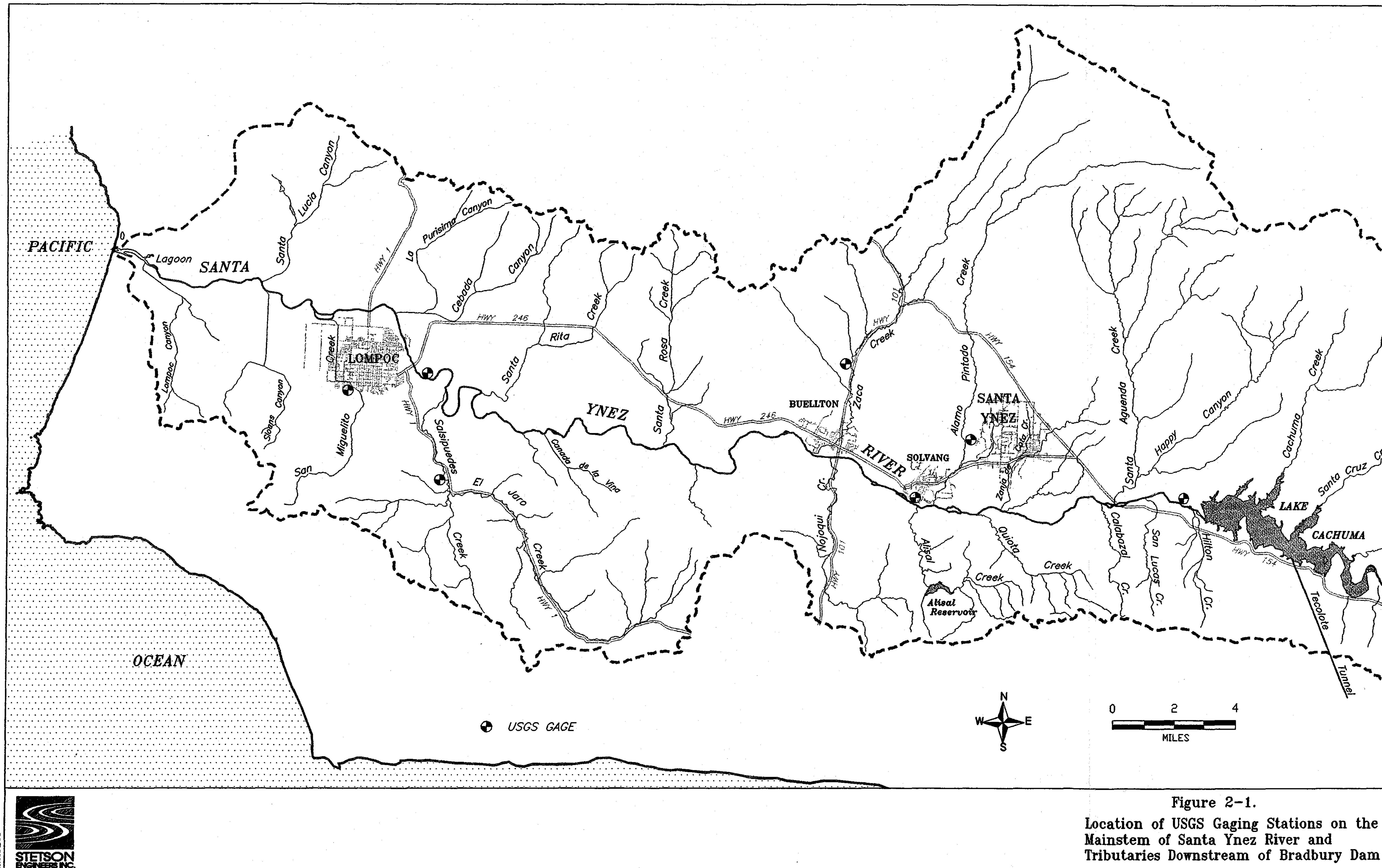


Figure 2-1.

Location of USGS Gaging Stations on the Mainstem of Santa Ynez River and Tributaries Downstream of Bradbury Dam

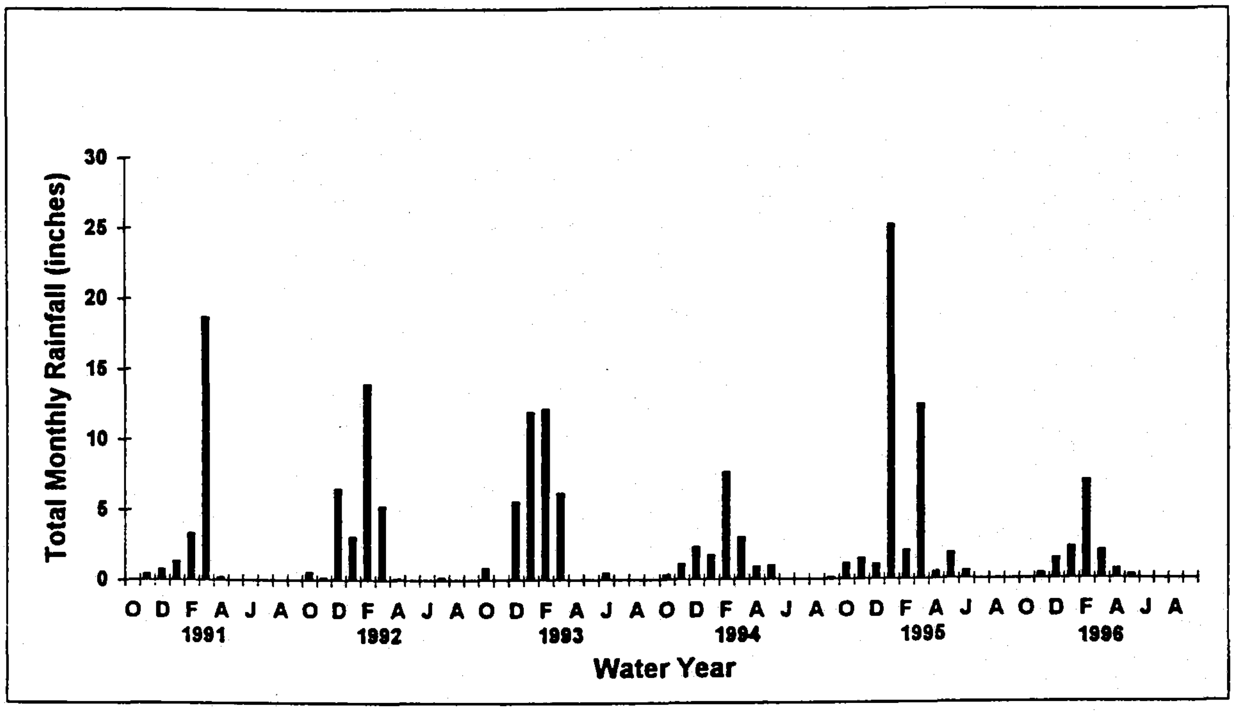


Figure 2-2. Total monthly rainfall as measured at Cachuma Reservoir, October, 1990 - August, 1996.

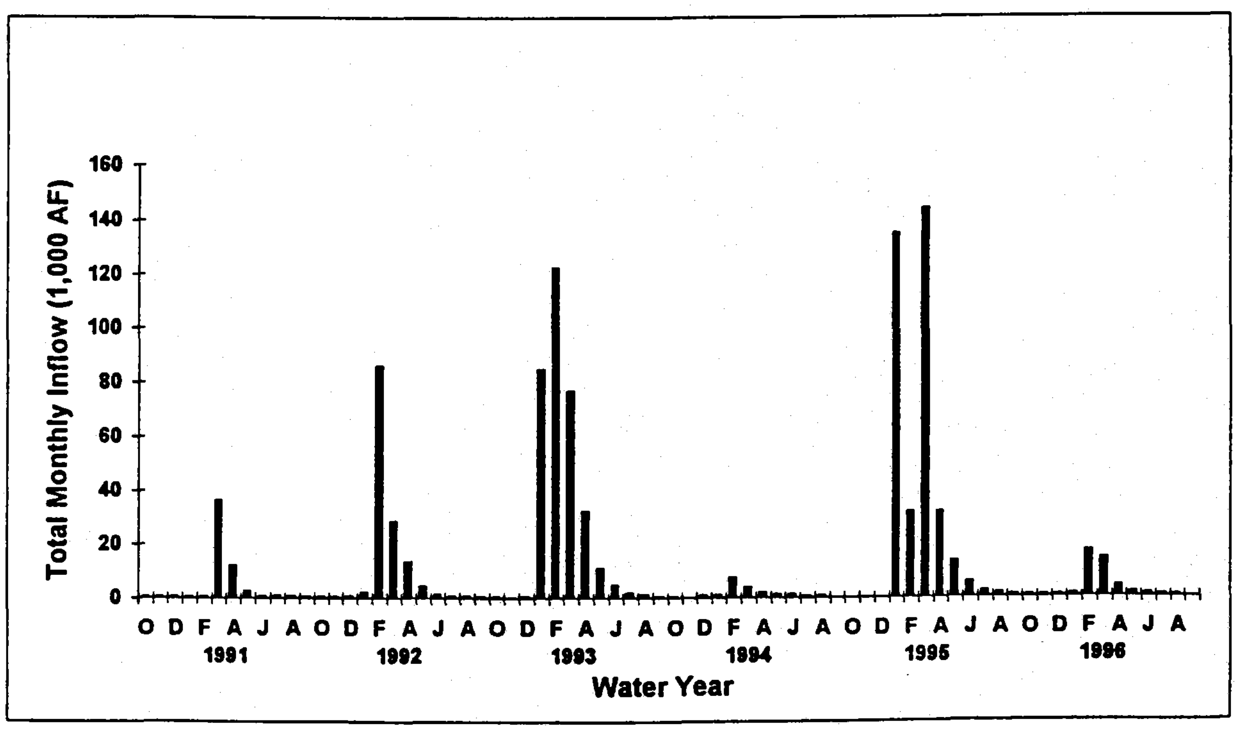


Figure 2-3. Total monthly inflow to Cachuma Reservoir, conditioned by the operation of Gibraltar and Juncal Dams, October, 1990 - August, 1996.

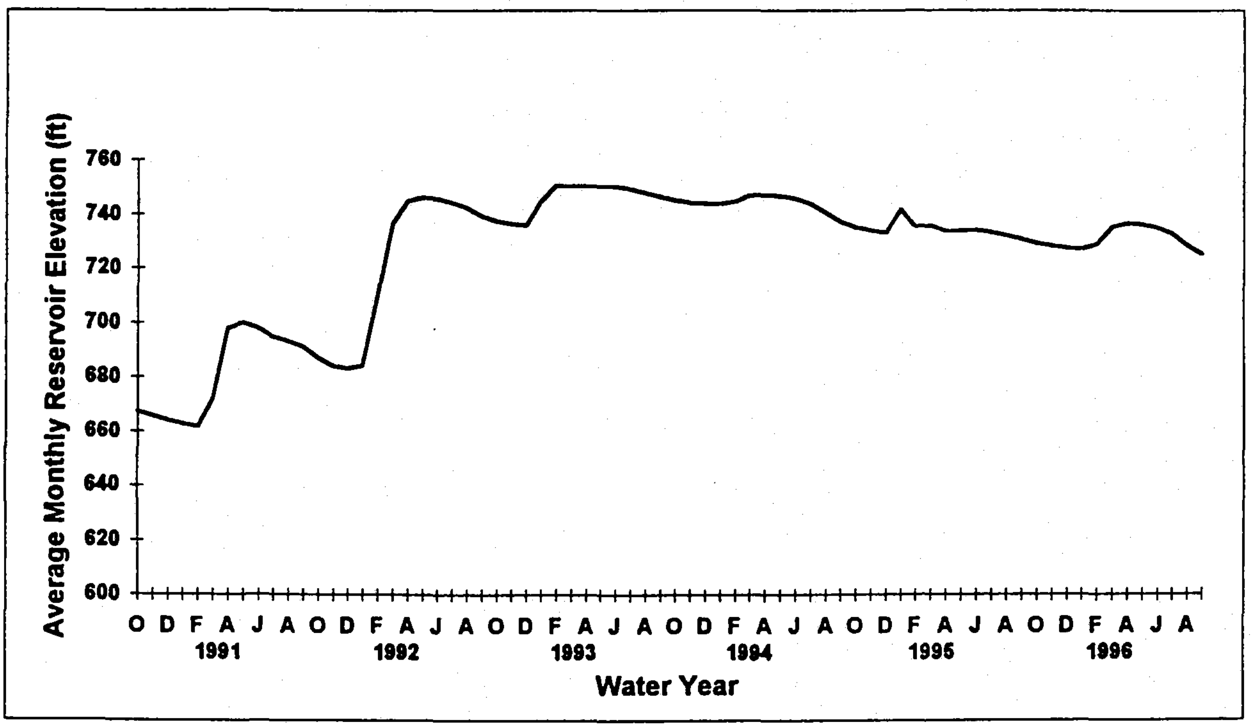


Figure 2-4. Average monthly water surface elevation within Cachuma Reservoir, October, 1990 - August, 1996.

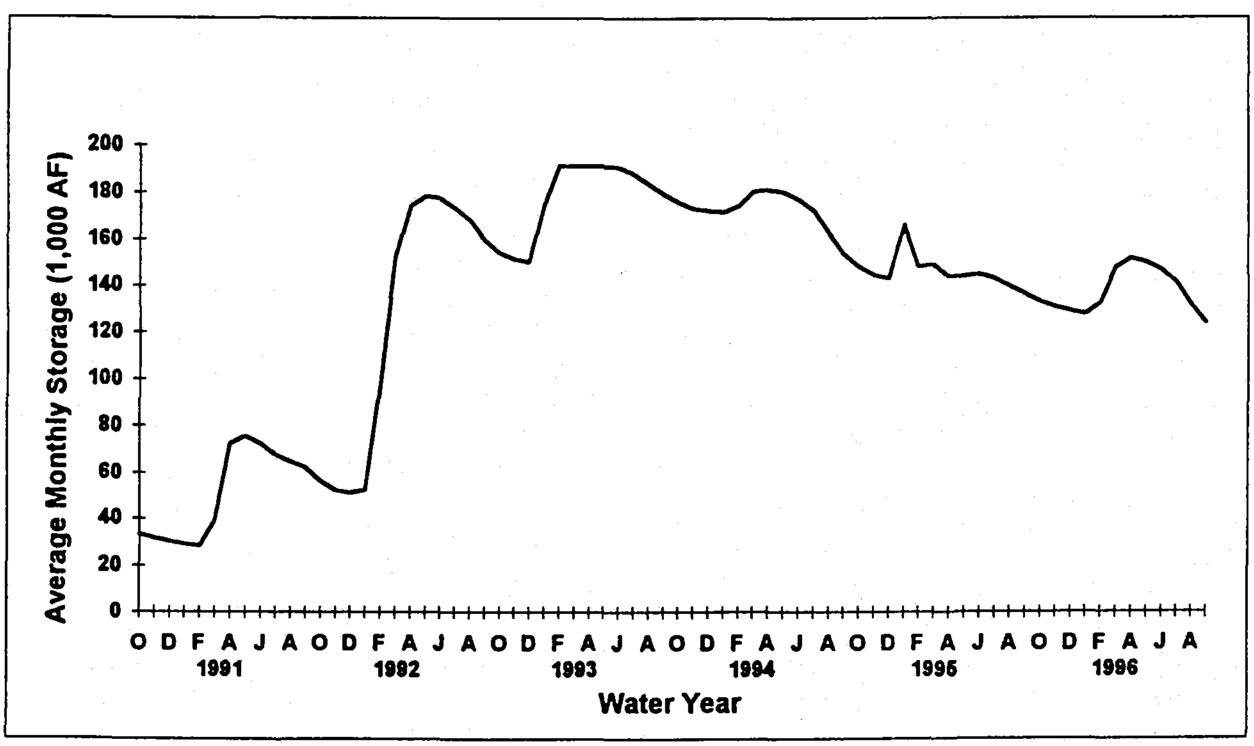


Figure 2-5. Average monthly storage volume within Cachuma Reservoir, October, 1990 - August, 1996.

The progression of relatively good years of rainfall precipitation in 1991, 1992, and 1993 (Figure 2-2) and the corresponding succession of years of increasing inflow to Lake Cachuma (Figure 2-3) is reflected in the increasing trend in both reservoir surface elevation and storage during 1991 and 1992 (Figures 2-4 and 2-5). Reservoir surface elevation, beginning in the summer of 1992 and continuing through the summer of 1996, has generally ranged from approximately 730 to 750 feet, with a corresponding storage volume ranging from approximately 130,000 to 190,000 AF.

2.3 Bradbury Dam Spill, Controlled Releases, and Fish Account Releases

Releases from Bradbury Dam for the period of interest have included spills from Lake Cachuma, controlled releases from Bradbury Dam to meet both seismic safety requirements and downstream water rights (e.g., WR 89-18 releases), and, beginning in 1993, releases from the reservoir as part of a fish reserve account established under the authority of the MOU.

Spills from Cachuma Reservoir occurred on two occasions between 1991 and 1996 (Figure 2-6); during the winter-spring (January-June) of 1993, and during the winter-early summer (January-early July) in 1995. The 1995 spills were to some extent regulated by the storage space made available due to the seismic safety requirements. Furthermore, the amount of spill was enhanced because the storage space in the Cachuma Reservoir was not filled at the end of the spill period. During the remainder of the period, no spills occurred from Bradbury Dam into the lower Santa Ynez River.

In accordance with SWRCB decision WR 89-18, controlled releases from the reservoir to meet downstream water user demands have occurred during the summer and fall in those years without spills Controlled releases were performed between June and October, 1991, July and October, 1992, July and October, 1994, and July and continuing to date, in 1996 (Figure 2-7). Controlled releases have been managed for groundwater recharge within the area from Bradbury Dam downstream to Lompoc. Controlled releases are managed to maximize the efficiency of groundwater recharge using water storage from Cachuma Reservoir during those years when natural hydrologic conditions of precipitation and storm water runoff do not meet the downstream demand for water supplies from the groundwater basin.

Beginning in 1993, and continuing, the MOU for the lower Santa Ynez River established an annual fish reserve account of 2,000 AF of water within Cachuma Reservoir, which could be allocated by designated representatives of the Technical Advisory Committee. Releases from the fish reserve account have been managed to (1) maintain and protect fisheries resources downstream of Bradbury Dam, and (2) conduct specific experimental studies used to evaluate the relationship between instream flow releases from Bradbury Dam and the corresponding response in water quality and/or biological resources at downstream locations.

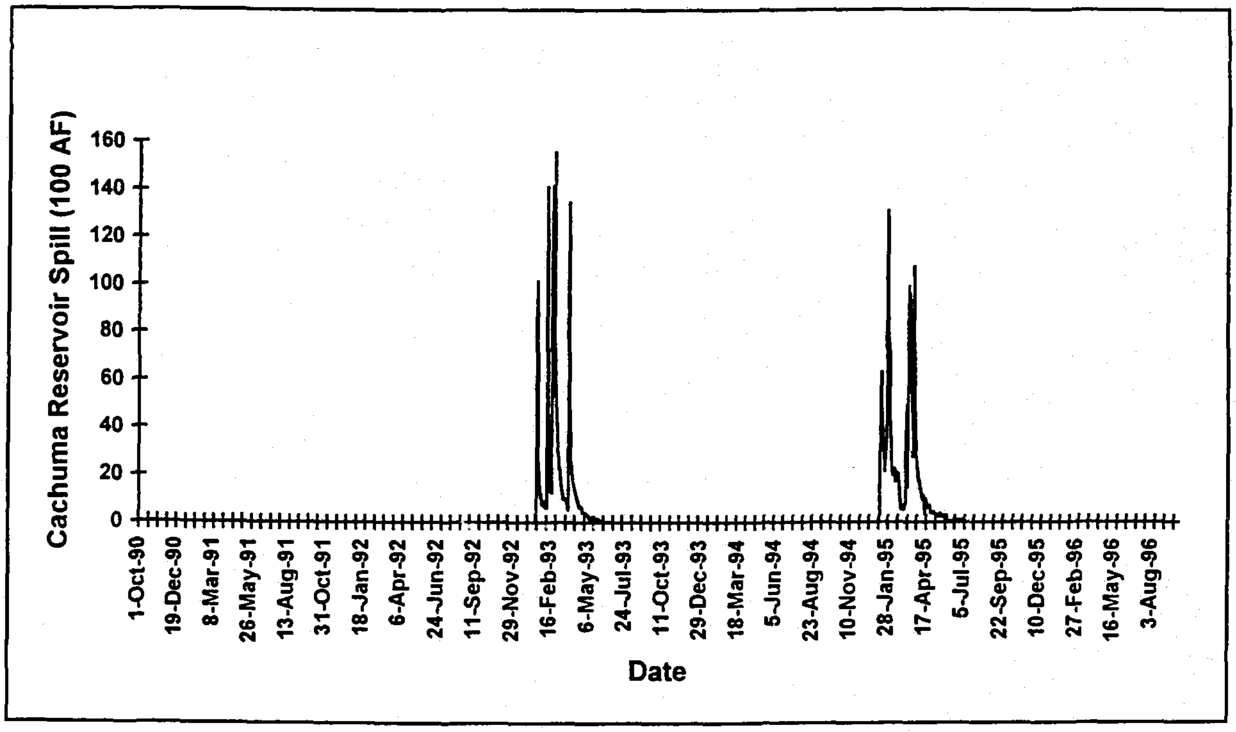


Figure 2-6. **Daily spill from Cachuma Reservoir, October, 1990 - August, 1996.**

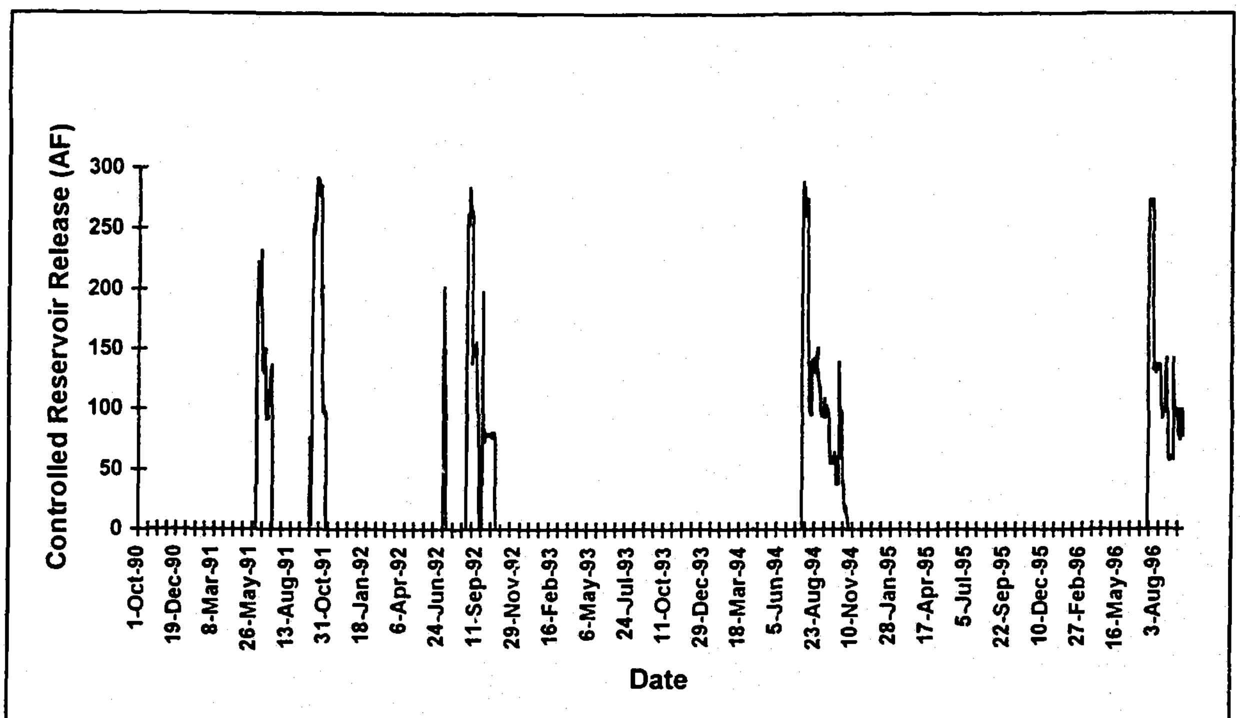


Figure 2-7. **Controlled releases from Bradbury Dam, October, 1990 - August, 1996.**

The allocation of water from the fish reserve account is shown in Figure 2-8. The first allocations occurred beginning in late June, 1993, with releases ranging from approximately 6-20 AF per day (1 cfs release is approximately 2 AF per day), through September, followed by a pattern of declining releases from the reserve account during October, November, and into mid-December. Releases from the fish reserve account also occurred beginning in mid-June, and continued through late-July, 1994, at various levels up to 20 AF per day. Additional releases from the fish reserve account were performed during the period from mid-July, 1995 and continued through mid-July, 1996, at a release rate typically ranging from approximately 5 to 10 AF/day (Figure 2-8).

The allocation of releases from the fish reserve account has been based on several considerations. The primary considerations are habitat condition and water quality (water temperature, dissolved oxygen concentrations, and water surface elevations) downstream of the dam within the Long Pool, and adjacent mainstem stream corridor habitat. The presence and abundance of juvenile and adult fish species, including rainbow trout/steelhead within the habitats immediately downstream of Bradbury Dam, is also considered in determining water allocations from the fish reserve account. Releases from the reserve account have been made to improve dissolved oxygen concentrations, maintain water depth within the Long Pool, and reduce the effects of algal accumulations on water quality and habitat conditions within pool habitats. Observations have shown that flows within the range of 3-5 cfs have not been sufficient to remove surface algae accumulation. Releases above 10-20 cfs have removed algae and improved dissolved oxygen concentrations.

Results of these preliminary investigations have demonstrated beneficial effects associated with only moderate releases from Bradbury Dam. Additional field investigations will be needed to better define the magnitude of flow necessary to reduce algal accumulations within various areas of the lower Santa Ynez River and improve dissolved oxygen concentrations. Results of these investigations will be used in identifying and evaluating potential costs and benefits associated with alternative management actions including, but not limited to, short-term low to moderate pulsed releases from Bradbury Dam on a seasonal basis to improve water surface elevation, reduce algal accumulations, and improve diurnal dissolved oxygen concentrations.

Consideration has also been given in the allocation of fish reserve account releases to augmenting or extending flows following winter storms. Finally, fish reserve account allocations have been managed to maintain, to the extent possible, instream flow releases during the period between completion of controlled releases (WR 89-18) in the fall and the beginning of rainfall in the late fall and winter. Fish reserve account allocations have not, to date, been utilized between the natural hydrologic recession occurring during the spring and the onset of WR 89-18 releases which are typically scheduled during the mid- to late summer. The development of management options should consider the potential biological benefits associated with fish reserve account releases, either as a low volume sustained release or short-term low to moderate volume pulsed release during the late spring and early summer in an effort to control and reduce algal blooms and

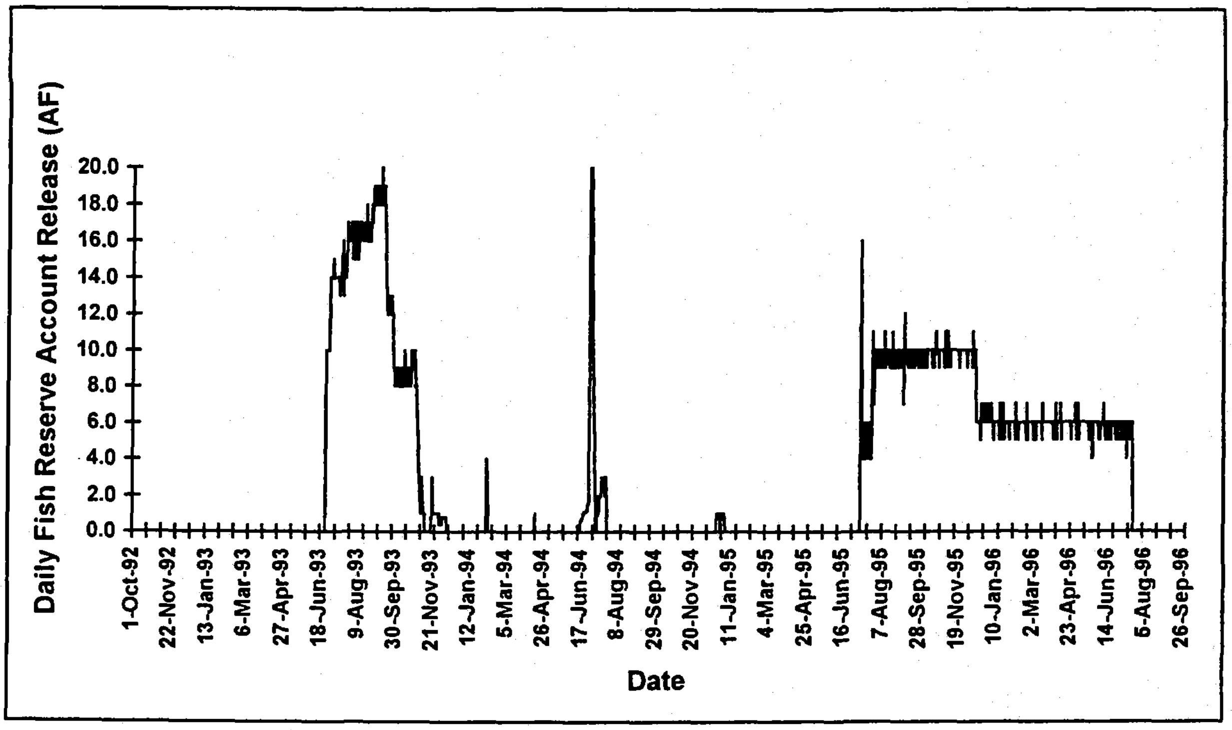


Figure 2-8. **Daily releases from the fish reserve account into the Santa Ynez River below Bradbury Dam, 1993-1996.**

accumulations that have been observed to occur, and contribute to, depleted diel dissolved oxygen concentrations, during the spring and summer period in the absence of "flushing flows".

2.4 Mainstem Santa Ynez River Flows

Flows within the mainstem Santa Ynez River downstream of Bradbury Dam are reflected in data collected at the USGS stream flow gauges at Solvang (Figure 2-9), and at the Narrows near Lompoc (Figure 2-10). During the period of these studies (1993-1996), average daily flows within the Santa Ynez River at Solvang have ranged from 0 to over 13,000 cfs. Flows within the river are characterized by high seasonal and inter-annual variability reflecting the combination of rainfall precipitation and storm water runoff within the Santa Ynez River basin (Figure 2-2), and spill, controlled releases from Bradbury Dam, and releases from the fish reserve account (Figures 2-6, 2-7, and 2-8).

A similar pattern of high seasonal and inter-annual variability in Santa Ynez River flows at the Narrows near Lompoc (Figure 2-10) is also apparent. Flows within the river near Lompoc are frequently higher than flows further upstream, reflecting the combined effects of groundwater upwelling and the contribution of tributary flows to the Santa Ynez River upstream of Lompoc.

2.5 Tributary Flow

Salsipuedes Creek

One of the principal tributaries to the mainstem Santa Ynez River downstream of Bradbury Dam is Salsipuedes Creek (Figure 2-1). Instream flows within Salsipuedes Creek (Figure 2-11) show a pattern of high variability seasonally and between years, reflecting rainfall precipitation and storm water runoff within the basin. Hydrologic conditions within Salsipuedes Creek reflect unimpaired hydrology, since there are no major impoundments on the creek, as well as no contribution of flows from Lake Cachuma or other upstream impoundments on the mainstem Santa Ynez River. An important attribute of Salsipuedes Creek, in terms of potentially available and suitable habitat for fisheries, is the fact that the creek is perennial and has had flows (although at frequently less than 1 cfs) consistently on a daily basis throughout the period 1991-1996 (Figure 2-11; Appendix B).

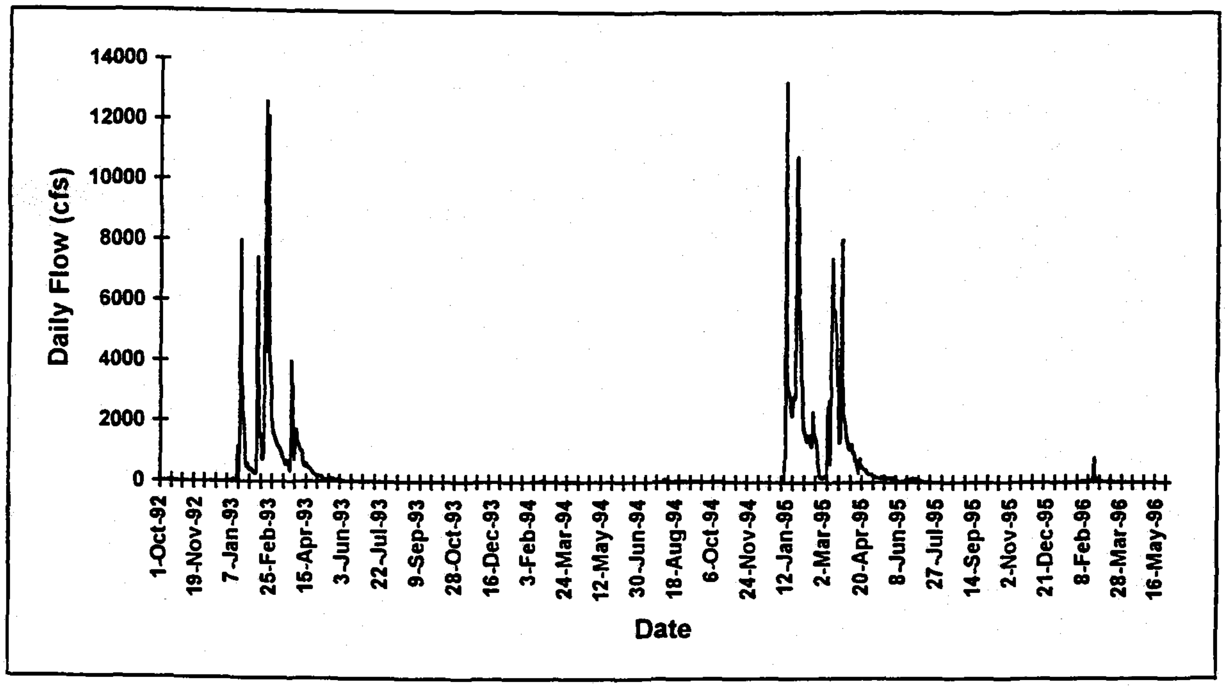


Figure 2-9a. Flow within the Santa Ynez River (arithmetic) as measured at the USGS gauging station at Solvang, October, 1990 - August, 1996.

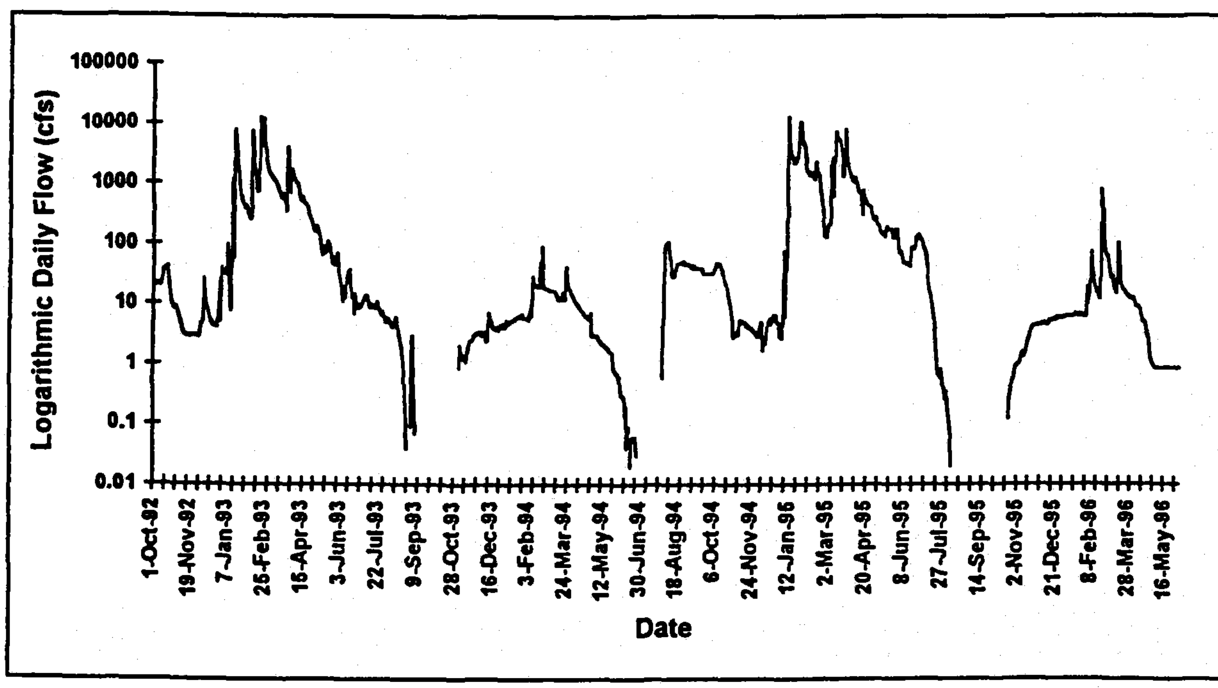


Figure 2-9b. Flow within the Santa Ynez River (logarithmic) as measured at the USGS gauging station at Solvang, October, 1990 - August, 1996.

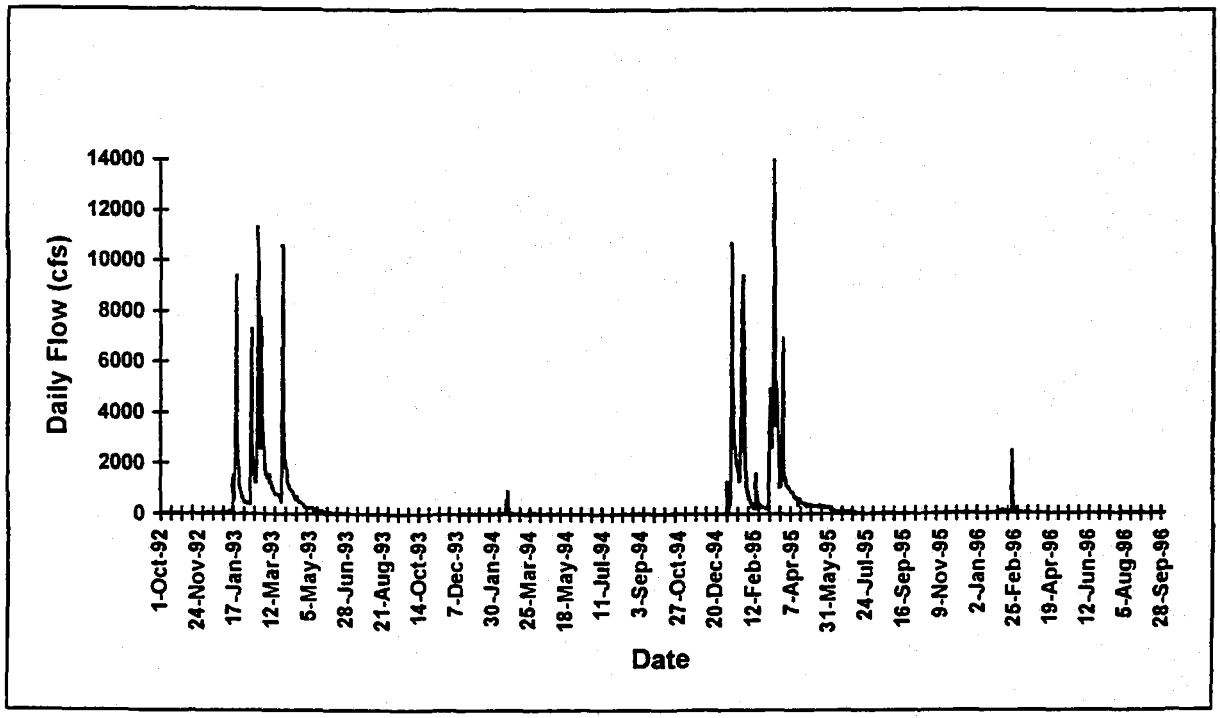


Figure 2-10a. **Flow within the Santa Ynez River (arithmetic) as measured at the USGS gauging station at the Narrows near Lompoc, October, 1990 - August, 1996.**

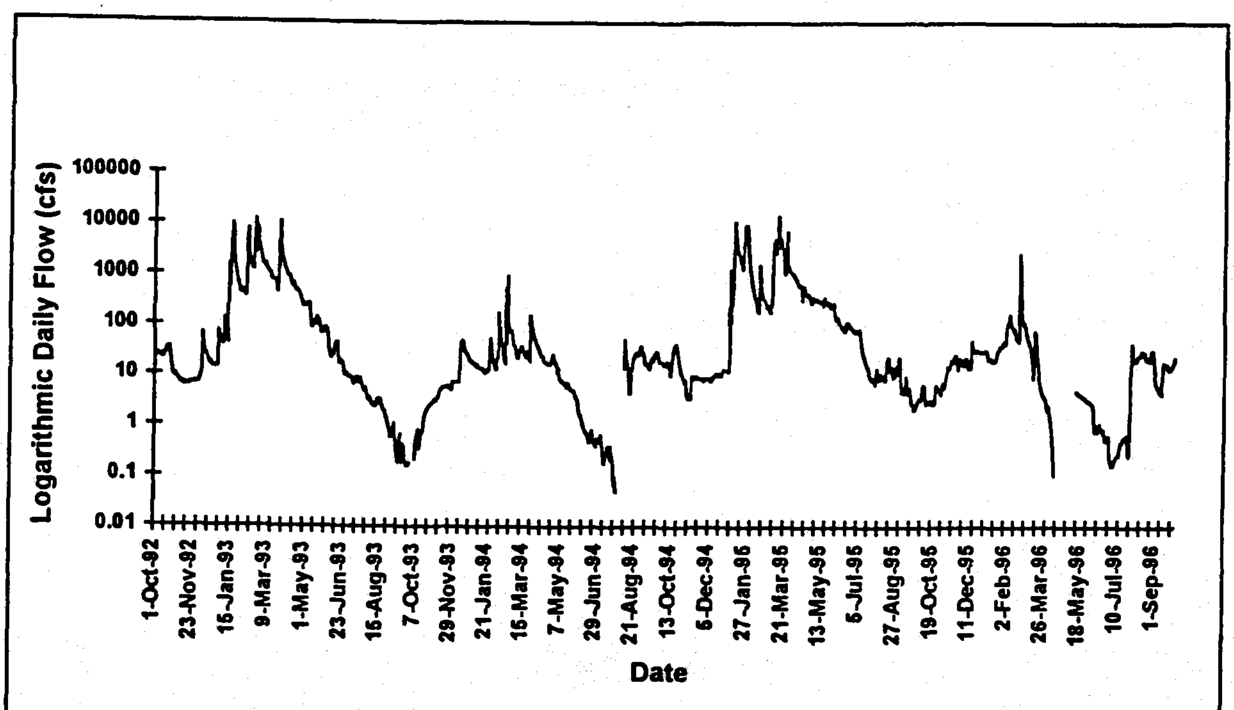


Figure 2-10b. **Flow within the Santa Ynez River (logarithmic) as measured at the USGS gauging station at the Narrows near Lompoc, October, 1990 - August, 1996.**

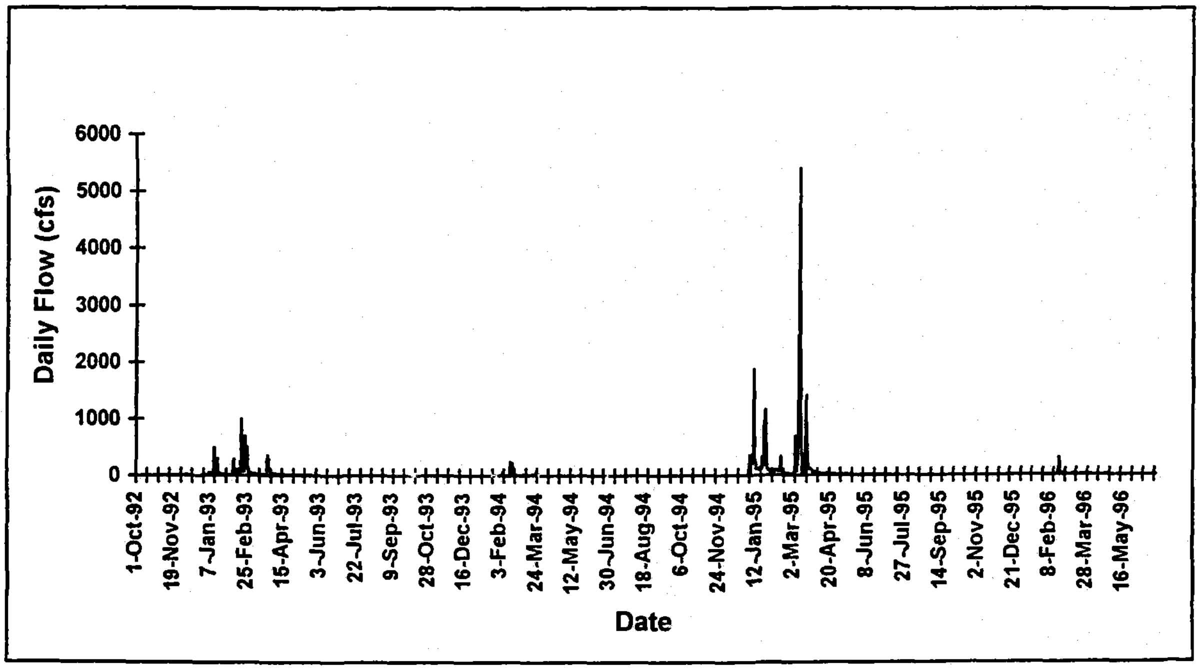


Figure 2-11a. **Daily flow within Salsipuedes Creek (arithmetic) as measured at the USGS gauging station near Lompoc, October, 1990 - August, 1996.**

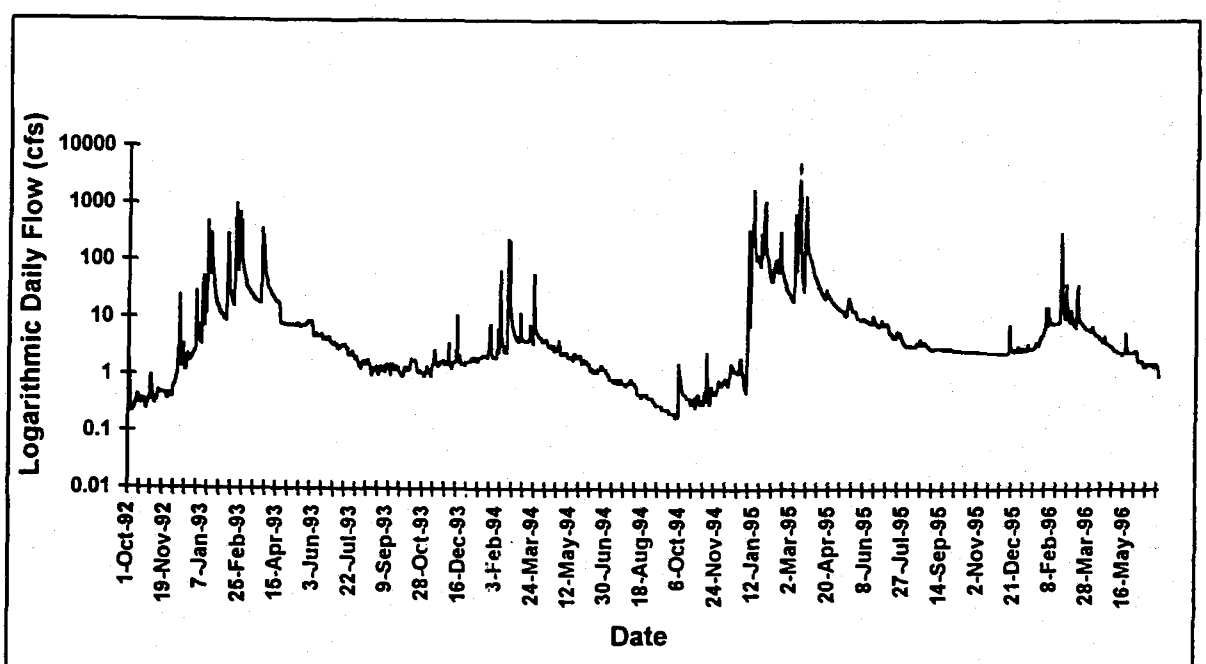


Figure 2-11b. **Daily flow within Salsipuedes Creek (logarithmic) as measured at the USGS gauging station near Lompoc, October, 1990 - August, 1996.**

Other Tributary Creeks

Stream flow data is available from USGS gauging stations on several additional tributary creeks to the Santa Ynez River. Flow data are available for 1991 and 1992 for Alamo Pintado Creek, near Solvang (Appendix B) which show a strong seasonal pattern. Alamo Pintado is intermittent in some places, going subterranean during the summer in its lower reaches. The USFWS and SYTAC biologists have observed that in upper Alamo Pintado Creek, surface flows remain throughout the summer and fall.

Zaca Creek, near Buellton, was also monitored in 1991 and 1992 (Appendix B), and showed a similar seasonal pattern of increased flow coincident with winter precipitation (of up to several hundred cfs), followed by extended periods of no measurable flow during the summer and fall.

San Miguelito Creek, near Lompoc, has also been monitored for the period 1991-1996 (Appendix B). Results of flow monitoring records show that flow within San Miguelito Creek typically occurs at a low rate (less than 0.1 cfs) throughout most years, with seasonal increases in flow coincident with winter rainfall and storm water runoff. Peak flow within San Miguelito Creek (March 11, 1995) exceeded 1,000 cfs.

Although there are a number of additional tributaries to the Santa Ynez River, including Hilton Creek, stream flow measurements in these areas have not been made using a USGS gauge. Visual observations as part of the 1993-1996 fisheries and habitat surveys show a consistent pattern of seasonal intermittent stream flow within most of these creeks, with relatively high, short-duration flows occurring coincident with winter rainfall and storm water runoff, followed by a reduction to little or no flow during the summer and fall. However, several of the tributaries to the Santa Ynez River are perennial, with surface water flows within at least a portion of the tributary year-round. Nojoqui, Upper Alisal, Salsipuedes, San Miguelito, and Quiota creeks are all perennial, but may not have sufficient flow to provide continuity with the Santa Ynez River mainstem throughout the year. Observations in the upper reaches of Hilton Creek (upstream of the shute pool and passage barrier) suggest that some water may remain throughout the year. Other creeks, including Alamo Pintado and Zaca are characterized by intermittent seasonal flows.

As part of fisheries and water quality monitoring, flow measurements have been made periodically within several of the tributaries to the Santa Ynez River. Flows have been estimated using velocity measurements, in combination with the cross-sectional area of the tributary. Instream flows measured within Salsipuedes Creek, both upstream and downstream of the confluence with El Jaro Creek, are presented in Table 2-1. Flows within Hilton Creek measured as part of these surveys are summarized in Table 2-2. Instream flows within Nojoqui and El Jaro creeks are presented in Tables 2-3 and 2-4, respectively. Flows measured in these tributaries as part of the fisheries and water quality sampling program, have been limited to data collected during 1995 and 1996.

Table 2-1. Flows measured in Salsipuedes Creek as part of fisheries and water quality studies.

Salsipuedes Creek upstream of El Jaro Creek

Date	Flow (cfs)	Date	Flow (cfs)
1995		*1996*	
April 25	4.7	April 8	0.9
September 11	0.8	May 4	0.7
October 11	0.8	May 19	0.6
December 11	0.6	June 26	0.7

Salsipuedes Creek two miles downstream of El Jaro Creek

Date	Flow (cfs)	Date	Flow (cfs)
1994			
December 29	1.3		
1995		*1996*	
January 3	23.8	January 4	3.4
January 4	21.3	January 25	3.6
January 5	40.0	February 1	8.2
January 31	71.1	February 5	6.6
February 2	57.7	February 24	12.9
May 26	12.4	March 4	11.5
September 11	3.1	March 15	10.1
October 3	6.0	May 4	3.1
October 11	3.1	May 19	2.6
December 11	3.5	June 12	2.1
		July 10	1.5

Table 2-2. Flows measured in Hilton Creek as part of fisheries and water quality studies.

Date	Flow (cfs)
1995	
January 20	1.8
January 26	32.9
January 30	8.0
February 1	4.6
February 12	2.5
February 14	21.2
March 4	3.2
March 5	6.2
March 5	40.1
March 6	8.8
March 20	5.4
March 21	10.8
March 22	7.5
March 24	24.7
April 8	4.3
April 27	2.1
1996	
February 20	5.4
February 21	2.9
February 22	1.3
March 15	0.7

Table 2-3. **Flows measured in Nojoqui Creek as part of fisheries and water quality studies.**

Date	Flow (cfs)
1995	
April 9	13.4
April 25	6.7
September 11	0.4
October 3	0.7
October 10	0.4
December 11	0.7
1996	
March 5	0.4
May 31	0.1
July 11	1.9

Table 2-4. **Flows measured in El Jaro Creek as part of fisheries and water quality studies.**

Date	Flow (cfs)
1995	
April 25	12.6
September 11	1.7
October 11	1.6
December 11	1.7
1996	
April 10	3.0
May 1	6.0
May 4	1.4
May 19	1.5
June 27	1.1

2.6 Breaching of the Lagoon

During March 1994, when the lagoon breach was open, it was observed to be about 30 ft wide and flowing one foot deep. At high tide, the flow was continuing to exit the lagoon. It is probable, however, that at the night high tide (predicted to be about 1.5 to 2 ft higher), the flow would reverse (enter the lagoon from the ocean). Santa Ynez River flow during this period was approximately 60 cfs, measured at the Narrows. During water quality sampling in August, 1993 and July, 1994, the breach was closed and the lagoon inflow was one cfs or less. In aerial photographs taken 20 May 1994, the breach was closed. Flow at that time was approximately six cfs at the Narrows.

Many environmental conditions are thought to influence the opening and closure of the San Ynez River lagoon. These factors include coastal sand transport and the processes that result in sand deposition and erosion such as currents, tidal action, storm activity, and wave action. Other factors include the freshwater inflow to the lagoon from the Santa Ynez River, local storm water runoff, and the volume of water (and water surface elevation) stored within the lagoon. The interaction among these dynamic physical processes determine whether the lagoon entrance is open (breached) or closed. No specific hydraulic studies have been performed as part of these studies to quantify the conditions that result in either opening or closure of the lagoon breach.

During periods in the past, the lagoon mouth has been breached mechanically using a bulldozer. Santa Barbara County Parks Department has mechanically breached the lagoon to reduce water levels and potential flooding at Ocean Park. Discussions with county park personnel, and representatives of Vandenberg Air Force Base have failed to identify historical records documenting the time of year when the lagoon mouth was breached by either natural processes or mechanical means.

No consistent records have been identified which identified either the frequency of breaching at the lagoon or the specific environmental conditions which contribute to breaching. Much of the information on inter-annual variation in breaching is therefore speculative. Breaching of the lagoon, however, is a significant event on the Santa Ynez River since the sandbar creates a passage barrier for both upstream and downstream migration of steelhead. Additional information is needed on the inter- and intra- annual frequency when the lagoon is breached, and improved documentation on the environmental conditions contributing to breaching of the bar. Additional consideration in terms of identifying and evaluating potential management actions should also consider the application of mechanical techniques (e.g., bulldozing the bar as has been done in the past) as a technique for allowing fish passage into and out of the lower Santa Ynez River.

To provide information regarding the lagoon and breaching of the bar, park department personnel have recently agreed to compile observations, beginning in 1996, on the lagoon and breaching of the bar at Ocean Park. Results of these observations, over a number of years, will provide valuable information on the seasonal occurrence of breaching of the bar and serve as a foundation for evaluating potential management actions designed to improve passage of steelhead and other fish species into and out of the lower Santa Ynez River. Information on breaching of the lagoon will need to be evaluated in context with both the objective of improving fish passage while also maintaining the integrity and environmental characteristics of the brackish water lagoon habitat which supports an estuarine fish community within the lower Santa Ynez River which includes the tidewater goby. Further consideration of the dynamics of the Santa Ynez River lagoon and bar will need to be evaluated in developing the Santa Ynez River management plan.

2.7 Summary

Hydrologic conditions within the Santa Ynez River Basin and tributaries are characterized by:

- High seasonal and inter-annual variability of instream flows and inflow to Cachuma Reservoir, which reflect patterns in seasonal precipitation and storm water runoff;

- During the period from 1991 through 1996, spill from Cachuma Reservoir has occurred during the winter-spring of 1993 and during the winter-early summer in 1995 (spill regulated and extended under the seismic operation), in response to periods of high precipitation and inflow to the reservoir;

- Controlled releases from Bradbury Dam have been made to recharge downstream groundwater basins to meet downstream water rights in accordance with SWRCB decision WR 89-18. Controlled releases were performed during 1991 (June-October), 1992 (July-October), 1994 (July-October), and in 1996 (July-October). Flows during controlled releases are up to approximately 150 cfs;

- Beginning in 1993 the Santa Ynez River MOU established a fish reserve account of 2,000 AF of water within Cachuma Reservoir, which has been managed primarily to maintain and protect fisheries resources downstream of the dam and on a limited basis to conduct specific experimental studies used to evaluate the relationship between instream flow releases and the corresponding response in water quality and/or biological resources at downstream locations. Releases from the fish reserve account (at a rate of 3 to 10 cfs, 6 to 20 AF per day) have been made on a seasonal basis in all years since 1993;

- Flow within the mainstem Santa Ynez River during the period of these studies (1993-1996) as measured at the USGS gauge at Solvang, have shown extremely high variability within and between years. Instream flows during this period have ranged from 0 to over 13,000 cfs. A similar pattern of high seasonal and inter-annual variability in Santa Ynez River flows is also apparent at the Narrows, near Lompoc;

- Tributaries to the Santa Ynez River downstream of Bradbury Dam show high variability seasonally and between years, reflecting precipitation and storm water runoff within the basin. Peak seasonal flows within several of the tributaries during the study period have exceeded 1,000 cfs. Many of the tributaries are characterized by intermittent flows, having no measurable surface flow during the late spring, summer, and early fall. Several of the creeks, including Salsipuedes and San Miguelito creeks have surface flow (although typically less than 1 cfs) throughout the year;

- A sandbar is present at the confluence between the Santa Ynez River and the Pacific Ocean. The sandbar creates a physical blockage for fish movement into or out of the Santa Ynez River, and also creates a lagoon characterized by a salinity gradient ranging from freshwater at the upstream boundary to full strength sea water at the downstream boundary. Periodically, the sandbar is breached (opened) allowing surface flow from the Santa Ynez River to enter the ocean, and creating an opportunity for both the upstream and downstream passage of migratory fish. Breaching of the lagoon typically occurs during winter months, coincident with storm activity and increased flows within the Santa Ynez River. In the past, the mouth of the lagoon has been breached mechanically, using a bulldozer, to reduce water elevation within the lagoon, and reduce the risk of localized flooding. The sandbar is not, however, breached in every year. No consistent records exist, however, for use in identifying either the inter- or intra-annual frequency of breaching of the bar or the specific environmental conditions, such as the magnitude of fresh water inflow to the lagoon, and other environmental factors which contribute to breaching of the bar. More rigorous observations and documentation on breaching of the bar and conditions within the Santa Ynez River lagoon have begun and will, over a period of years, provide additional information and insight into the dynamics of the lagoon and breaching of the bar which will serve to help refine the evaluation of potential management options.

- Seasonal and inter-annual variability of instream flows within the mainstem Santa Ynez River and tributaries represents a major factor influencing habitat quality and availability for various fish species and the associated water quality conditions. Instream flows also effect breaching of the sandbar and conditions for upstream and downstream passage of migrating fish (e.g., water depths and velocities) within the Santa Ynez River tributaries and mainstem. The influence of these flow conditions on water quality (temperature, dissolved oxygen, and salinity) habitat characteristics, and the distribution of various fish species within the system will be discussed in subsequent chapters.

3.0 WATER QUALITY CONDITIONS

Water quality conditions, particularly instream water temperature and dissolved oxygen concentrations below Bradbury Dam, in addition to salinity within the lagoon, have a direct influence on species composition and habitat use. Water temperature is influenced by a variety of factors including seasonal air temperature and solar radiation, river shading, instream flow, water temperatures at the release from Cachuma Reservoir, water depth, and in some areas the influence of groundwater upwelling. Dissolved oxygen concentrations are influenced by turbulence and mixing, instream flows, water temperature, photosynthetic activity during the daytime, and metabolism by algae at night. Salinity conditions within the lagoon are influenced by the balance of salt water intrusion from the ocean and freshwater inflow from the Santa Ynez River. These water quality parameters vary seasonally among locations within both the mainstem river and tributaries. The physiological tolerance of aquatic species, including various fish species and life stage, determine the suitability and use of habitats by these species.

A variety of water temperature criteria have been reported for rainbow trout and steelhead in the scientific literature. To help the reader interpret the potential biological significance of temperature data collected during the 1993-1996 investigations, thermal criteria were developed from the scientific literature for use as a general guideline in evaluating temperature data. The temperature guidelines were founded primarily on results of laboratory and experimental investigations conducted using steelhead from the more northern portion of their geographic distribution (e.g., Oregon, Washington, and British Columbia). Water temperatures in the Pacific Northwest are much cooler than they are along California's central coast. It has been hypothesized, therefore, that thermal tolerance of northern populations may be lower than the actual tolerance for stocks inhabiting the southern end of their geographic distribution. No definitive data are available, however, on the thermal tolerance of southern steelhead stocks and particularly rainbow trout/steelhead inhabiting the lower Santa Ynez River, for use in developing thermal tolerance indices.

A temperature criterion of 20 C (68 F) for daily average water temperatures has been used in central and southern California by CDFandG to evaluate the suitability of stream temperatures for rainbow trout. This criterion represents a water temperature below which reasonable growth of rainbow trout may be expected. Data in the literature suggest that temperatures above 21.5 C (71 F) result in no net growth or a loss of condition in rainbow trout (Hokanson *et al.* 1977). Since the upper incipient lethal temperature for rainbow trout is approximately 25 C (77 F), a binary criterion was developed for determining usable trout habitat based on the available literature, suggesting that average daily temperatures should be less than 20 C (68 F) and daily maximum temperatures should be less than 24 C (75 F) to allow acceptable trout growth (Entrix 1995). U.S. EPA (1976) arrived at similar criteria for rainbow trout. In the absence of more definitive data on the thermal tolerance of steelhead inhabiting the southern portion of their geographic distribution, and particularly those fish inhabiting the lower Santa Ynez River, the thermal tolerance criteria (frequency of average daily temperatures greater than 20 C, and frequency of maximum daily temperatures greater than 25 C) should, therefore, not be used as absolute thermal thresholds, but rather represent general guidelines for assessing the biological significance of water temperature conditions monitored during the 1993-1996 period of these investigations.

Dissolved oxygen concentrations also affect habitat quality and use, physiological stress, and mortality for fish and other aquatic organisms. In general, dissolved oxygen concentrations less than 5 mg/l are considered to be unsuitable for most fish species, including rainbow trout/steelhead (Bell 1986). Higher minimum dissolved oxygen concentrations may be necessary in some systems for successful egg incubation and hatching for species such as rainbow trout/steelhead.

Different fish species have different tolerance ranges for salinity. Some species exhibit a very narrow range of salinity tolerances (stenohaline, e.g., exclusively freshwater or marine), while other species may be tolerant of a wide range of salinity (euryhaline). Within an estuary, including the Santa Ynez River lagoon, salinity may range from freshwater to full strength sea water. Salinity may also stratify vertically within the Santa Ynez River lagoon, which affects water quality considerations.

In the following sections, data collected on air temperature, water temperature, dissolved oxygen, and salinity conditions within the Santa Ynez River downstream of Bradbury Dam have been compiled and summarized. In addition, measurements of water temperature and dissolved oxygen concentrations occurring within Cachuma Reservoir are also presented, since they have a direct bearing on water quality conditions entering the lower river.

3.1 Air Temperature

<u>Santa Ynez Airport</u>

Air temperatures, particularly during summer, contribute significantly to increased water temperatures. Air temperatures measured at the Santa Ynez Airport between January, 1993 and September, 1996 are summarized in Table 3-1. Air temperatures show a general seasonal pattern with increasing temperatures during the spring and summer, and decreasing temperatures during the fall and winter. The maximum daily average air temperature observed at the Santa Ynez Airport occurred in August of 1993, 1994 and 1995, and in July, 1996. Average daily temperature in August, 1993 was 18.4 C (65.1 F), with a range in average daily minimum and maximum air temperatures from 12.5 to 27.0 C (54.5 to 80.6 F). Average daily air temperature in August, 1994 was slightly higher at 18.8 C (65.8 F), with a range in the average daily minimum and maximum air temperatures from 11.7 to 29.2 C (53.1 to 84.6 F). Average daily air temperature in August, 1995 was similar at 18.3 C (64.9 F), with a range from 11.0 to 29.4 C (51.8 to 84.9 F). Average daily and maximum air temperatures during the summer, 1996, were substantially greater than air temperatures during the same time period in 1995. Average daily air temperatures during the summer of 1996 were 17.3 C (63.1 F) in June, 20.1 C (68.2 F) in July, 19.8 C (67.6 F) in August, and 17.8 C (64.0 F) in September. Maximum daily temperatures in 1996 occurred in July (31.2 C; 88.2 F), and August (31.3 C; 88.3 F). The general trend in seasonal and inter-annual variability in air temperatures at the Santa Ynez Airport are shown in Figure 3-1. Although the seasonal patterns show some

Table 3-1. 1993-1996 monthly air temperatures (C) at Santa Ynez Airport.

Month 1993	Average Daily Maximum	Daily Average	Average Daily Minimum
January	16.0	10.2	4.9
February	15.8	10.4	5.5
March	20.3	12.9	7.6
April	21.7	13.2	6.3
May	23.3	15.5	8.6
June	26.8	17.8	10.2
July	24.8	17.4	11.9
August	27.0	18.4	12.5
September	26.9	17.3	10.8
October	24.7	16.0	10.1
November	21.0	12.6	5.8
December	17.6	9.4	3.3

Month 1994	Average Daily Maximum	Daily Average	Average Daily Minimum
January	19.4	9.8	2.8
February	15.9	9.5	4.1
March	19.5	12.3	6.9
April	19.0	12.3	7.3
May	20.1	13.5	8.7
June	26.2	16.2	8.7
July	25.5	16.4	10.8
August	29.2	18.8	11.7
September	27.1	17.0	10.5
October	24.1	14.9	8.3
November	17.5	9.5	2.9
December	17.1	9.2	3.0

Month 1995	Average Daily Maximum	Daily Average	Average Daily Minimum
January	15.0	10.8	7.3
February	22.2	13.7	7.8
March	17.9	12.1	7.0
April	19.8	12.6	6.7
May	19.2	13.3	8.9
June	23.5	15.7	9.8
July	27.9	18.3	12.0
August	29.4	18.3	11.0
September	27.3	17.1	10.5
October	25.9	15.7	8.9
November	24.0	14.1	7.5
December	18.3	10.9	5.5

Month 1996	Average Daily Maximum	Daily Average	Average Daily Minimum
January	18.0	10.6	N/A
February	17.6	12.1	N/A
March	19.1	11.9	N/A
April	23.4	15.0	N/A
May	24.4	15.7	N/A
June	26.5	17.3	N/A
July	31.2	20.1	N/A
August	31.3	19.8	N/A
September	28.4	17.8	N/A

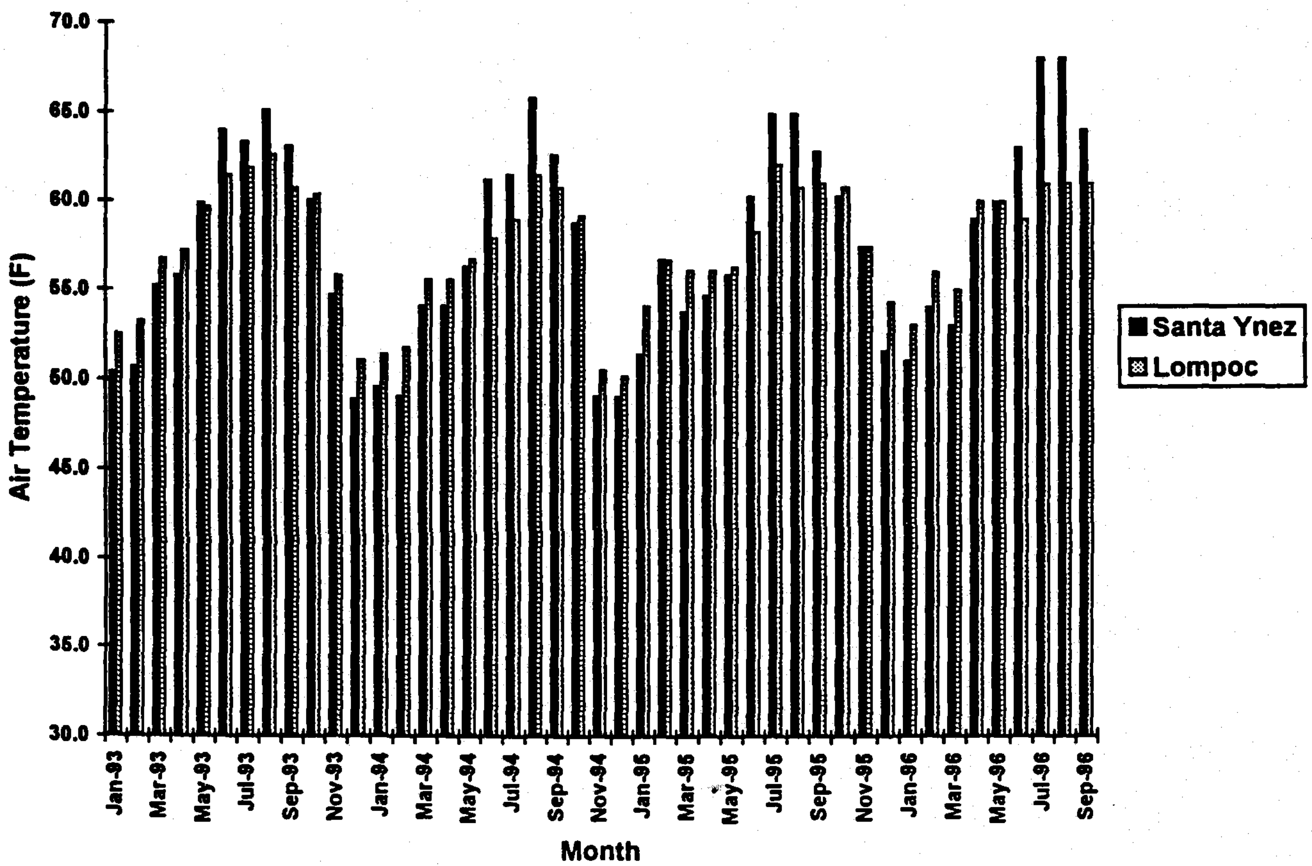


Figure 3-1. **Average monthly air temperatures measured at the Santa Ynez Airport and Lopoc: 1993-1996.**

variability between years, the general trend in air temperatures was similar among the three years encompassed by these surveys.

Lompoc

Daily air temperatures in 1995 were substantially cooler in Lompoc compared to the Santa Ynez Airport reflecting, in part, the influence of the coastal marine climate. Average monthly, minimum and maximum air temperatures measured at Lompoc during the period from January, 1993 through September, 1996 are summarized in Table 3-2. The seasonal pattern in air temperatures, although generally similar to that further upstream at the Santa Ynez Airport, had a peak average daily temperature in October. In general, air temperatures at Lompoc were cooler than air temperatures further upstream at the Santa Ynez Airport during the summer, and were generally warmer at Lompoc during the fall and winter. Average daily air temperature in August, 1993 was 17.0 C (62.6 F), with a range in average daily minimum and maximum temperatures from 14.1 to 21.2 C (57.4 to 70.1 F). Average daily air temperature during August, 1994 was 16.4 C (61.5 F), with a range in average daily minimum and maximum temperatures from 13.2 to 21.0 C (55.7 to 69.8 F). Average daily temperatures during August, 1995 were 16.0 C (60.8 F), with a range in average daily minimum and maximum temperatures from 12.6 to 20.8 C (54.7 to 69.4 F). Average daily air temperatures at Lompoc during the peak summer month (August) were 1.4 to 2.3 C lower when compared to those recorded at the Santa Ynez Airport. The seasonal trend and inter-annual variability in average daily air temperatures at Lompoc are shown in Figure 3-1.

3.2 Lake Cachuma Temperature and Dissolved Oxygen Profiles

Limnological conditions within Lake Cachuma vary seasonally following a typical pattern of stratification during the spring and summer, and destratification during the late fall and winter. During periods of stratification within the reservoir water temperatures near the surface of the reservoir (epilimnion) are typically warmer than water temperatures near the bottom of the reservoir (hypolimnion). During the period of stratification dissolved oxygen concentrations are also higher in the epilimnion than those observed in the hypolimnion. During the period of fall turnover, and destratification of the reservoir, water temperatures and dissolved oxygen concentrations are relatively uniform throughout the water column. These seasonal limnological conditions not only influence water quality conditions within the reservoir but also influence the seasonal temperature of waters released downstream into the lower Santa Ynez River. Information regarding seasonal trends in vertical dissolved oxygen and temperature profiles within Cachuma Reservoir can be used to determine the availability of cold water within the reservoir hypolimnion, which could be used to meet downstream temperature conditions for rainbow trout/steelhead. Hypolimnetic releases have been used, or are being considered for use, within a number of reservoir systems to provide operational flexibility to meet downstream temperature criteria for juvenile rearing and oversummering conditions. In addition, information regarding the vertical distribution of water temperatures within the reservoir has been used in the preliminary feasibility assessment and engineering design for alternative management actions being considered on the Santa

Table 3-2. 1993 - 1996 monthly air temperatures (C) at Lompoc

Month 1993	Average Daily Maximum	Daily Average	Average Daily Minimum
January	16.0	11.4	7.1
February	16.2	11.8	7.5
March	19.1	13.7	9.9
April	19.4	14.0	9.6
May	20.5	15.4	10.7
June	21.8	16.4	11.9
July	20.5	16.6	13.9
August	21.2	17.0	14.1
September	21.1	16.0	12.4
October	22.1	15.8	11.3
November	20.4	13.2	7.7
December	17.2	10.6	5.4

Month 1994	Average Daily Maximum	Daily Average	Average Daily Minimum
January	18.3	10.8	5.2
February	16.2	11.0	6.5
March	18.5	13.1	8.7
April	17.5	13.1	9.5
May	17.5	13.7	10.5
June	19.5	14.4	10.5
July	18.8	15.0	12.6
August	21.0	16.4	13.2
September	21.2	16.0	12.4
October	21.7	15.1	9.9
November	16.6	10.3	4.7
December	16.1	10.1	5.2

Month 1995	Average Daily Maximum	Daily Average	Average Daily Minimum
January	15.6	12.3	9.4
February	19.4	13.7	9.5
March	18.1	13.4	9.5
April	18.4	13.4	9.2
May	17.1	13.5	10.8
June	18.8	14.6	11.4
July	21.7	16.7	13.3
August	20.8	16.0	12.6
September	21.1	16.1	12.7
October	22.9	16.0	10.9
November	20.6	14.1	9.7
December	17.3	12.4	8.3

Month 1996	Average Daily Maximum	Daily Average	Average Daily Minimum
January	17.5	11.9	N/A
February	17.8	13.4	N/A
March	18.2	12.9	N/A
April	21.6	15.3	N/A
May	20.5	15.3	N/A
June	19.5	15.0	N/A
July	21.2	16.2	N/A
August	21.1	16.0	N/A
September	21.3	15.9	N/A

Ynez River, including the recent design of the Hilton Creek siphon (Stetson Engineers, 1996) to take maximum advantage of the available cold water reserves within the reservoir.

To investigate these water quality conditions and evaluate the potential effects of seasonal conditions and reservoir storage volume on water quality, an element of the Santa Ynez River study program included periodic monitoring of water temperature and dissolved oxygen within the reservoir. Water quality surveys were scheduled to occur quarterly to account for seasonal variation.

Temperature and dissolved oxygen measurements have been made vertically at approximately 1 m (3.3 ft) intervals at three locations within Lake Cachuma (Figure 3-2). Sampling Sites were located in the deeper areas within the reservoir. Site 1 is located approximately 40 m from the water intake, adjacent to the dam face. Site 2 is located off Tequepis Point, approximately 0.5 miles upstream of the dam. Site 3 is located off the Tecolote Tunnel, approximately 1 mile upstream of the dam. Water quality surveys have been performed four times per year in 1994 and 1995, with three surveys completed to date in 1996. In 1994, profiles were measured in August, September, November, and December; in 1995, profiles were measured in April, June, September, and November; in 1996, profiles were measured in May, July, and August. Results of temperature and dissolved oxygen measurements within the reservoir are summarized below for the sampling station (Site 1) located adjacent to Bradbury Dam.

Water Temperature

Sunlight striking the surface of a lake will heat it more at the surface and thus form a layer of less dense warmer water overlying a denser cooler zone. In deep lakes during summer, stratification results in an upper warm layer - the epilimnion; a cool, dense deep layer - the hypolimnion; and a transitional zone between them - the thermocline, or metalimnion (Goldman and Horne 1983). The greater the difference in water temperature between the epilimnion and hypolimnion, the greater the stability of stratification within the reservoir.

Water temperature measurements collected in 1994 reflect the seasonal pattern in reservoir stratification (Figure 3-3). In 1994, stratification was firmly established in August and September with the epilimnion extending to a depth of approximately 14 m (46 ft). Temperatures were warmer in the epilimnion in August (24-27 C) than in September (22 C). By November, the epilimnion had increased in depth to approximately 16 m (53 ft) and water temperature had cooled to 18 C indicating a breakdown in the epilimnion. The thermocline or metalimnion, extended roughly five meters (16 ft)past the bottom of the epilimnion in August, September, and November. Temperatures in the metalimnion represent the temperature variation between warm surface waters and cool bottom waters (15-22 C). In December, fall turnover had occurred with uniform temperatures of 13 C from surface to bottom (40 m; 130 ft). The hypolimnion (area of coolest water) extended past the 20 m (65 ft) level in all months with temperatures varying seasonally between 8-12 C.

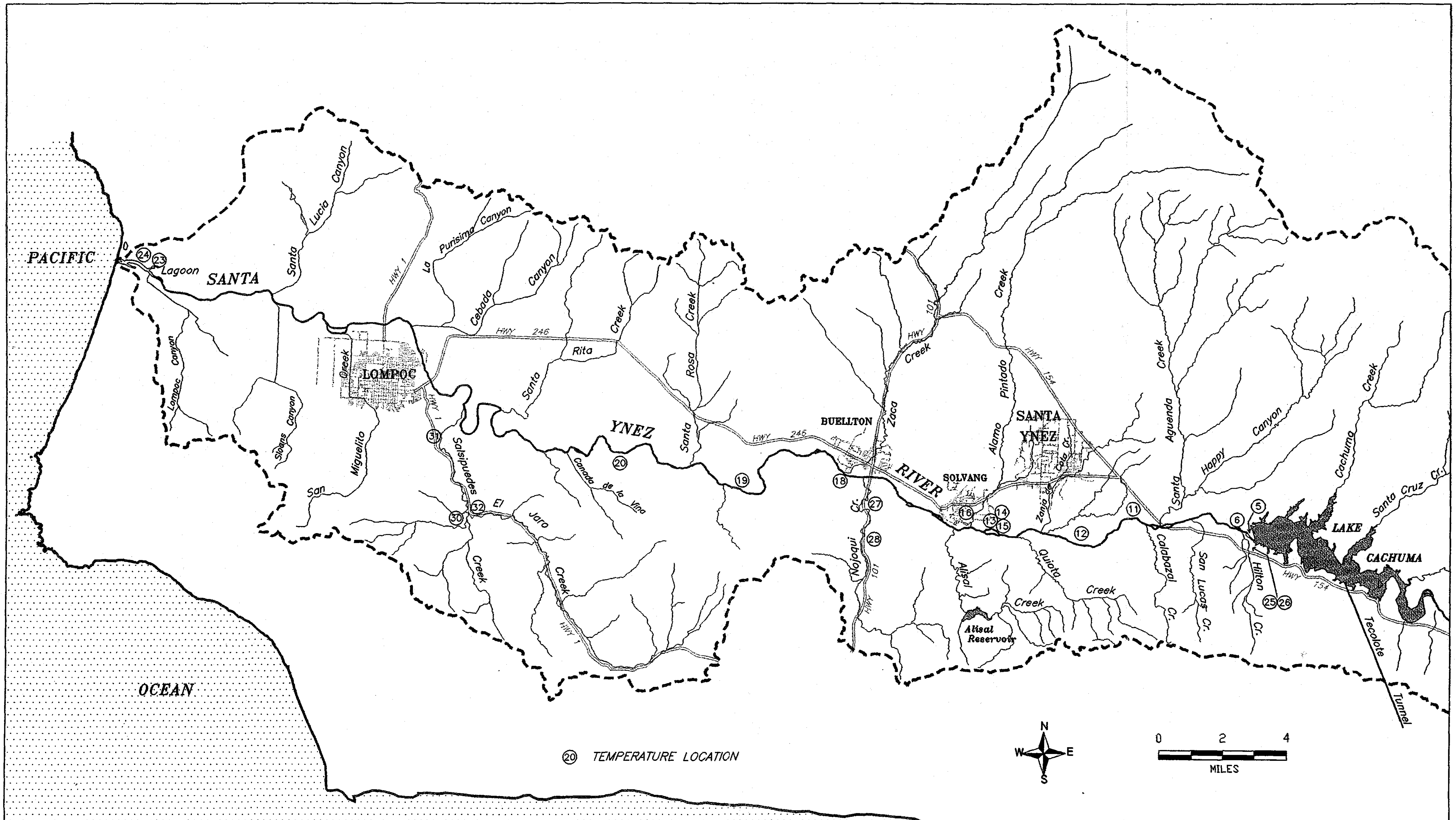


Figure 2.5-1.
Water Temperature Monitoring Locations In the Mainstem and Tributaries of the Santa Ynez River

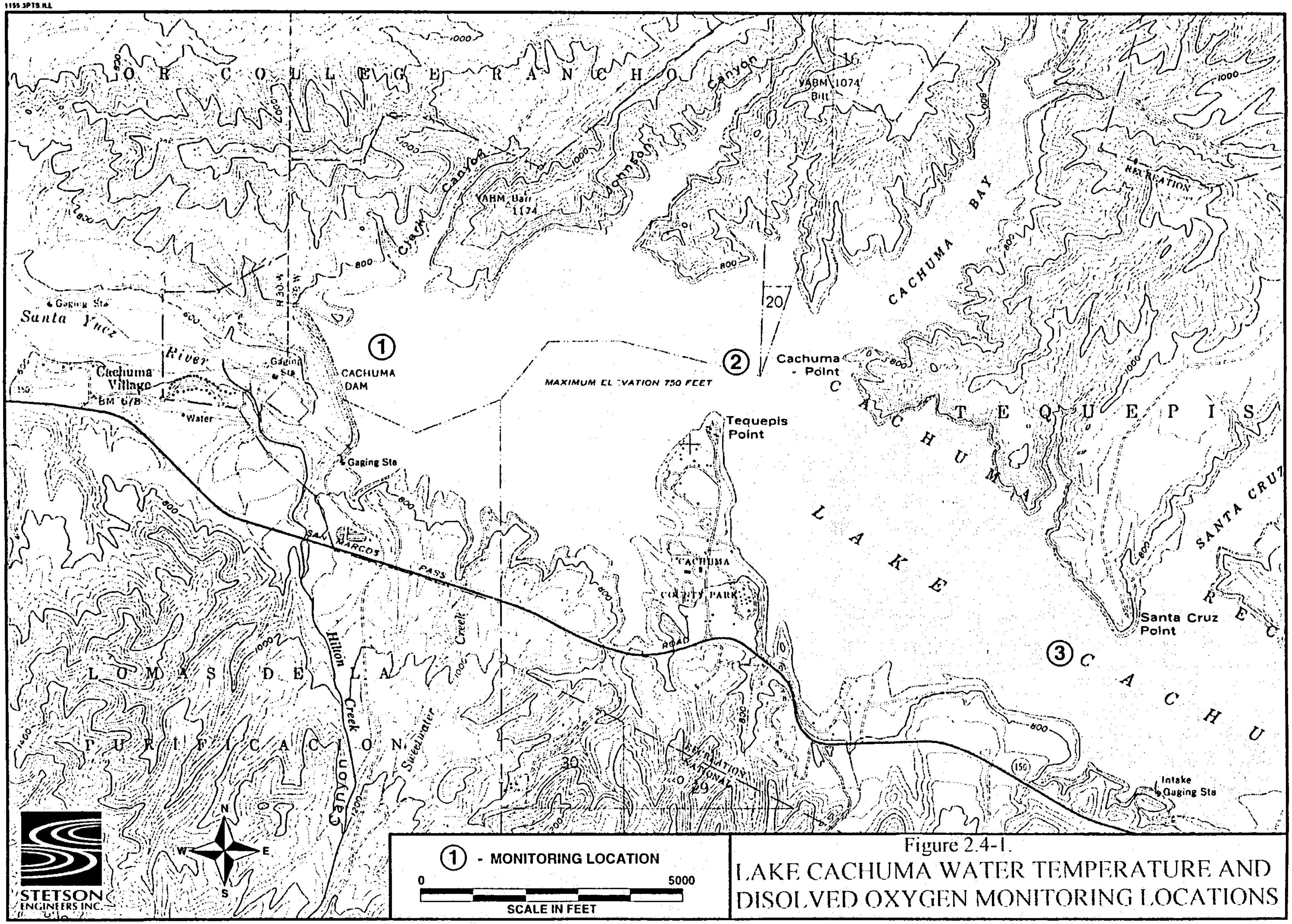


Figure 2.4-1.
LAKE CACHUMA WATER TEMPERATURE AND DISOLVED OXYGEN MONITORING LOCATIONS

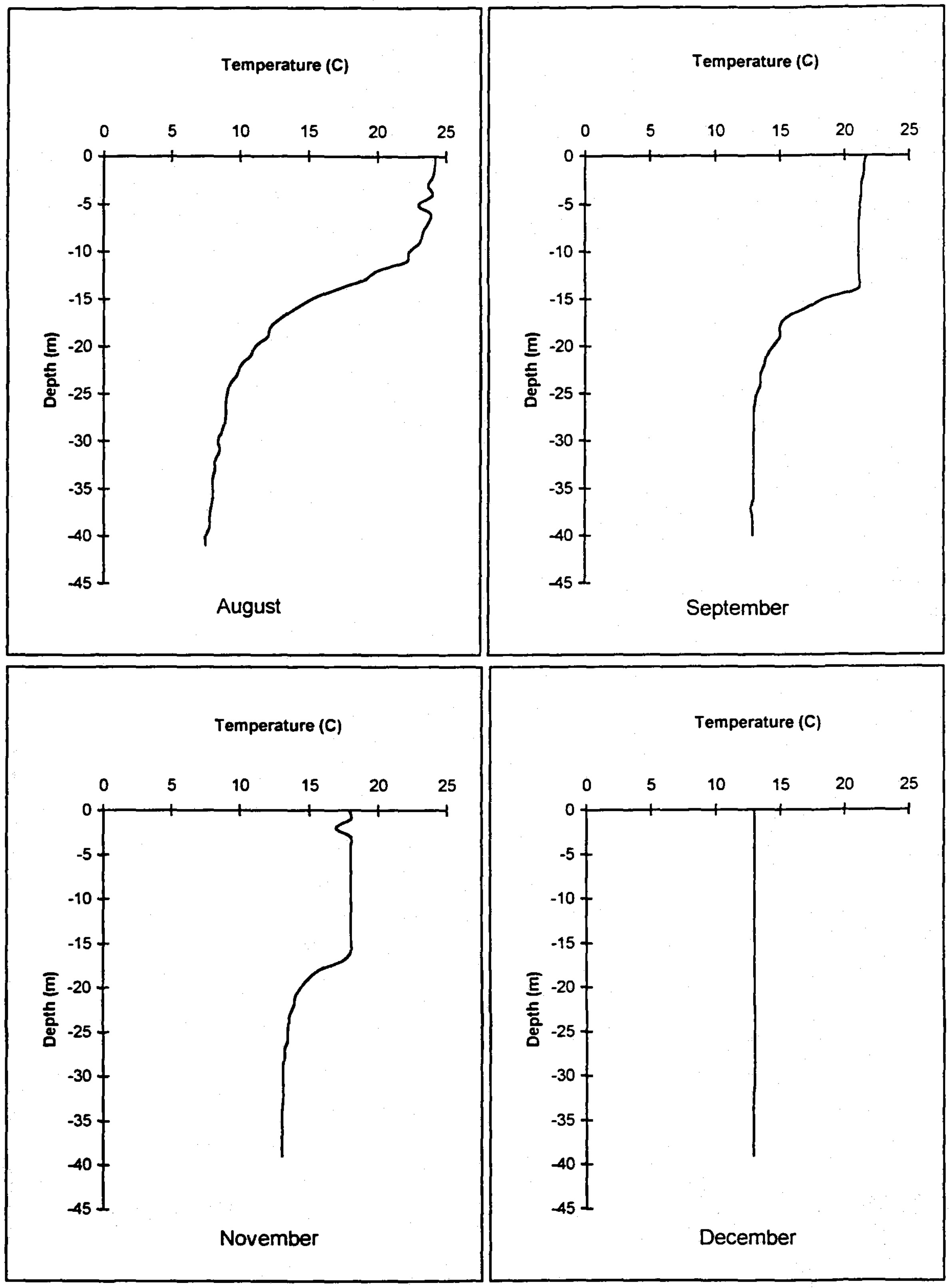


Figure 3-3. Vertical temperature profiles within Lake Cachuma, 1994.

Profiles measured in 1995 indicate stratification began to establish in April (Figure 3-4). During April, water temperature was 3-4 C greater in the upper 7-13 m (23-43 ft) of the water column. Surface temperatures were 16-18 C. Bottom temperatures ranged between 13-14 C. In June the onset of stratification is more evident. The thermocline was apparent at a depth of approximately 12 m (40 ft). Surface temperatures in June ranged between 20-21 C, while bottom temperatures were 15 C. During September the warm water (22-24 C) epilimnion extended from the surface to a depth of 11 m (36 ft). The cool water hypolimnion (15-16 C) extended from 15 m to 40 m (49 to 130 ft). In November, similar conditions developed as in 1994. The epilimnion increased approximately one meter in depth, and temperature decreased by 3 C indicating a breakdown in the epilimnion.

Temperature profiles measured in 1996 were similar to those observed in 1995 (Figure 3-5). In addition, profiles in water temperature during the summer and early fall of both 1995 and 1996 show epilimnion temperatures between 20-24 C, and hypolimnion temperatures between 15-17 C. Water temperature within the reservoir hypolimnion measured during the summer (August) was approximately 5-7 C higher in 1996 compared to 1994.

Dissolved oxygen

Lake Cachuma experiences severe hypolimnetic dissolved oxygen depletion during the summer and fall after the reservoir becomes stratified. Dissolved oxygen measurements in September and November 1994 show uniform dissolved oxygen concentrations of 8-9 mg/l from the surface to a depth of approximately 16 m (53 ft; Figure 3-6). From depths of 16 m to 40 m (53 to 130 ft), dissolved oxygen sharply decreased to less than 2 mg/l during both September and November. When fall turnover occurred sometime between November 2 and December 8, surface and bottom waters mixed resulting in nearly uniform dissolved oxygen concentrations of 7-7.5 mg/l.

Seasonal patterns in dissolved oxygen profiles were similar between 1995 and 1996. In 1995 and 1996, dissolved oxygen in the epilimnion ranged between 6-8 mg/l, while in the hypolimnion dissolved oxygen ranged from 3-6 mg/l (Figures 3-7 and 3-8). Once the reservoir became stratified (summer through fall), a marked decrease in hypolimnetic dissolved oxygen concentrations below 2 mg/l was observed. Dissolved oxygen concentrations in the epilimnion remained greater than 8 mg/l throughout the survey period.

3.3 Santa Ynez River Mainstem Temperature

Water temperature monitoring on the mainstem Santa Ynez River and tributaries has been one of the primary elements of the 1993 - 1996 studies. Over the period of these investigations, water temperature has been measured at a variety of locations (Figure 3-9), using various temperature monitoring instruments (e.g., Hobo, Ryan Tempmentor,

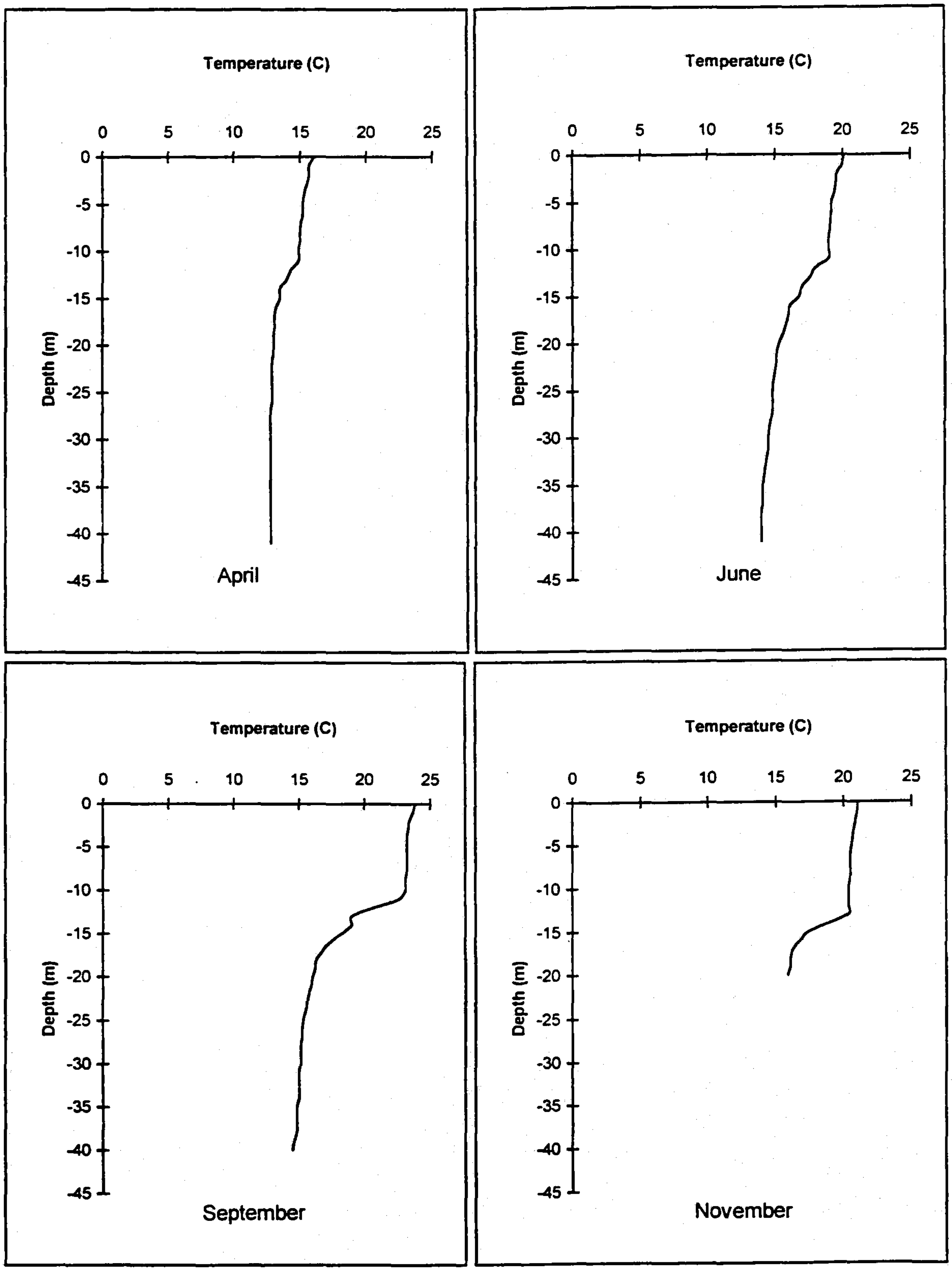


Figure 3-4. Vertical temperature profiles within Lake Cachuma, 1995.

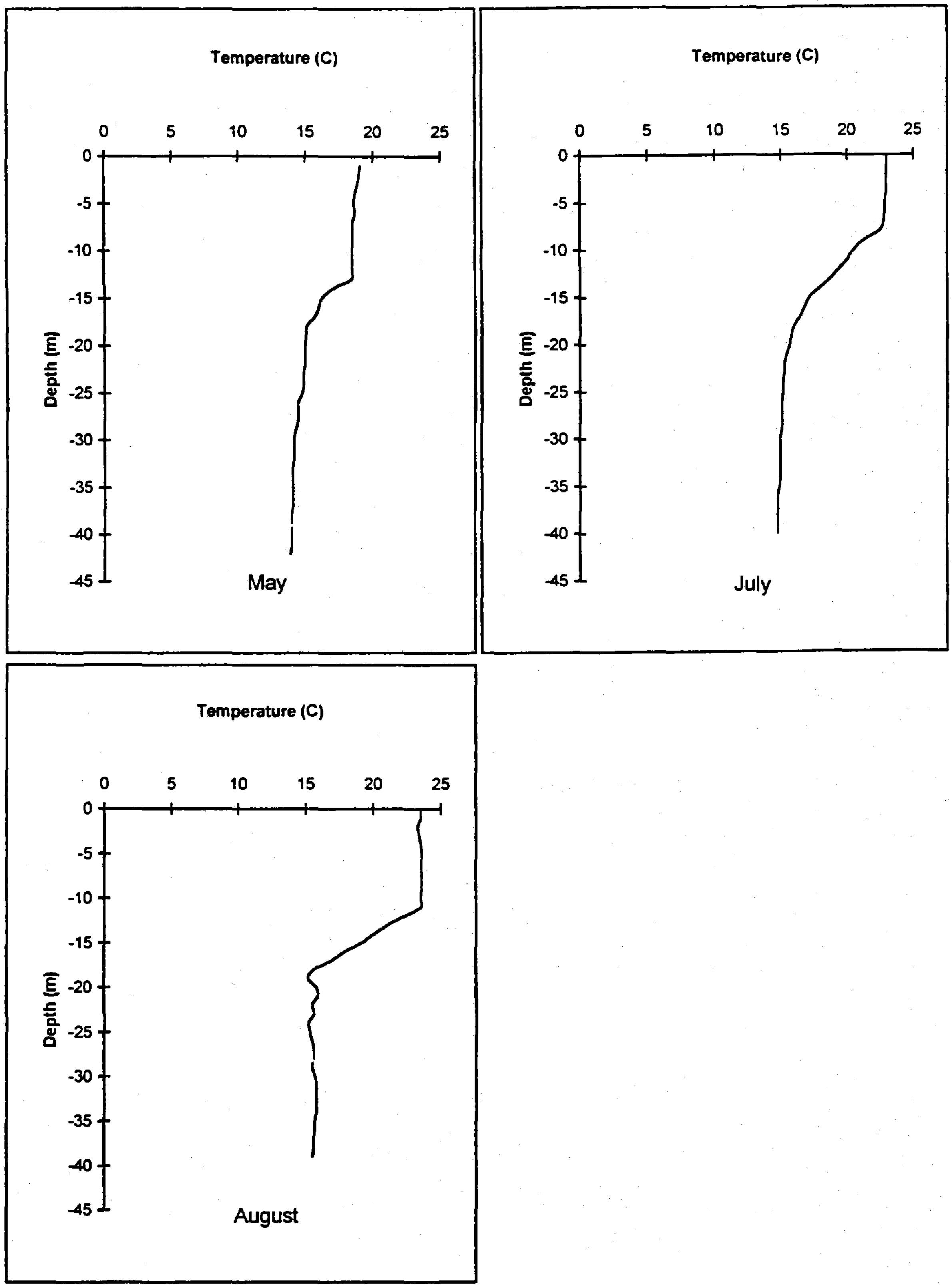


Figure 3-5. Vertical temperature profiles within Lake Cachuma, 1996.

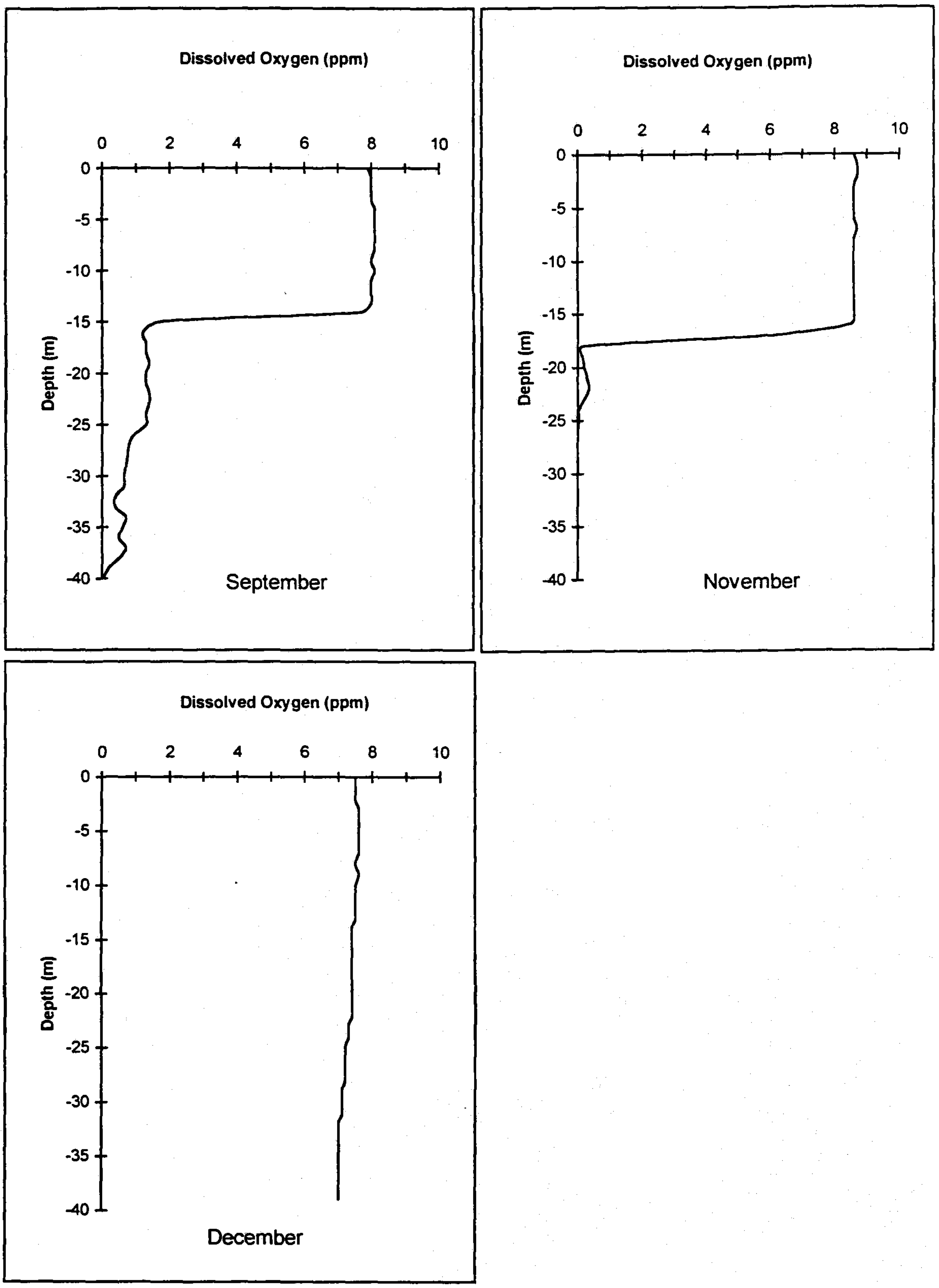


Figure 3-6. Vertical dissolved oxygen profiles within Lake Cachuma, 1994.

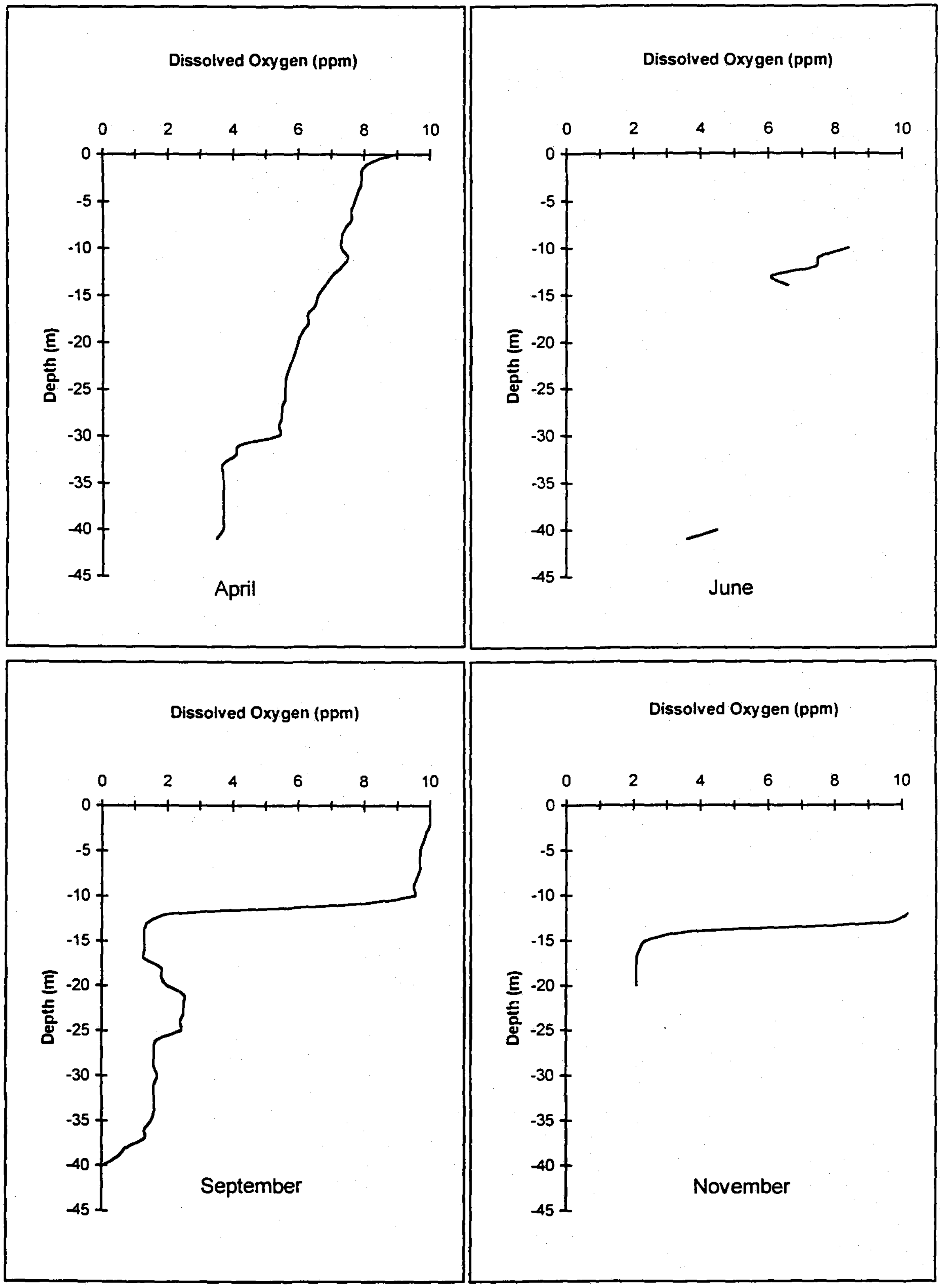


Figure 3-7. Vertical dissolved oxygen profiles within Lake Cachuma, 1995.

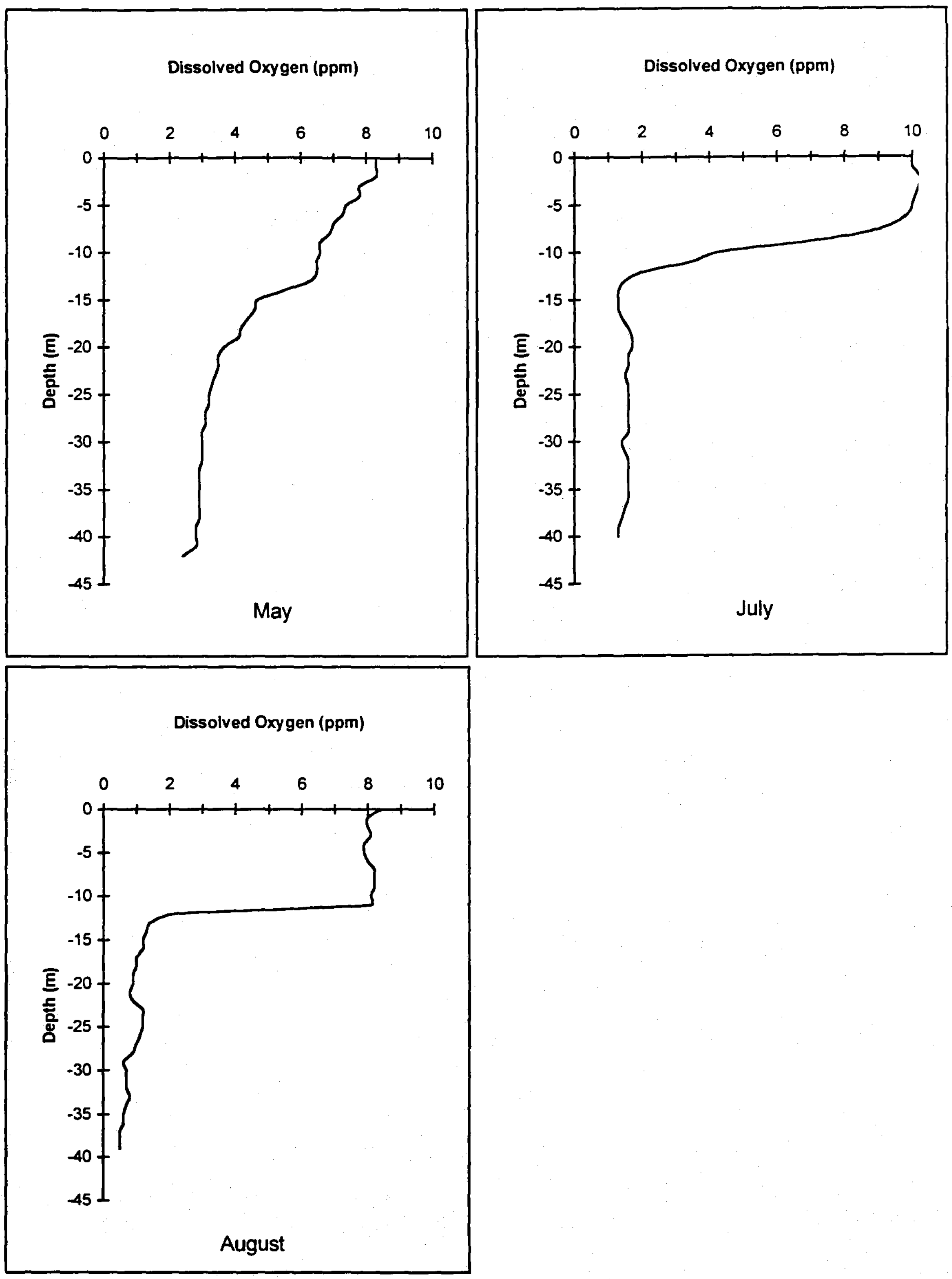


Figure 3-8. Vertical dissolved oxygen profiles within Lake Cachuma, 1996.

Optic Stowaway, etc.). During 1993 and 1994, water temperature monitoring was conducted by the California Department of Fish and Game (CDFandG), and Hanson Environmental, Inc. The use of different temperature monitoring equipment by several groups of investigators, during the early periods of these investigations, contributed to a lack of consistency and continuity within the resulting databases as a result of (1) variation in calibration, frequency of data recording, and operation of the different temperature monitoring equipment, (2) the loss of temperature recorders during high flows, buried by sediment deposits, and as a result of vandalism, and (3) periodic relocation of temperature monitoring stations in response to changes in river flow and water depth seasonally.

The issue of consistency and continuity within the temperature database was discussed on a number of occasions by the Santa Ynez River Technical Advisory Committee. Maintaining a relatively stable network of temperature monitoring locations is an important feature in the subsequent analysis and interpretation of temperature monitoring results and evaluating the influence of river flow, air temperature, and the longitudinal gradient downstream of the dam on seasonal patterns in water temperature. The location of water temperature monitoring stations has been based, in part, on patterns of sediment scour and deposition within the river channel, areas having deeper water pools, and locations where vandalism of temperature monitoring equipment is reduced. Despite these precautions during the 1993-1996 monitoring period, temperature recording instruments at various locations were lost due to sediment deposition, lost during periods of high flow, as a result of vandalism and disruption, and instrument failure. Based upon the experience during the 1993-1996 period, modifications have been implemented to improve the continuity and integrity of the water temperature monitoring element of this investigation.

The years in which temperature monitoring has been performed at various locations within Cachuma Reservoir, the mainstem Santa Ynez River, and tributaries are summarized in Table 3-3. It should be noted, however, that temperature monitoring occurred at many of these locations during only a portion of any given year.

Beginning in 1995, temperature monitoring within the Santa Ynez River system and tributaries was modified to include greater standardization in monitoring equipment and techniques (routine water temperature monitoring is being conducted using Optic Stowaway temperature monitoring units, under the direct supervision of Scott Engblom). Temperature monitoring stations have also been modified to include greater standardization to provide consistent temperature monitoring at specific locations, including the addition of vertical temperature arrays at those locations having sufficient water depth. The habitat characteristics at those locations where water temperature monitoring is currently being conducted as part of the Santa Ynez River fisheries and water quality investigations are summarized in Table 3-4. Although temperature monitoring results from the 1993 - 1994 studies provides a valuable basis for comparing general trends in seasonal and inter-annual variability in water temperatures, the data collected in 1995 - 1996 provide the most consistent, reliable data available on water temperature conditions within the system, and therefore have been used as the primary basis for comparisons and analyses presented in this report.

Table 3-3. Summary of water temperature monitoring locations within Cachuma Reservoir Mainstem Santa Ynez River, and Tributaries, 1993-1996.

Location Designation[1,2]		Miles From Bradbury Dam	1993	1994	1995	1996
	Cachuma Reservoir					
1	Bradbury Dam (Site 1)			X	X	X
2	Tequepis Point (Site 2)			X	X	X
3	Tecolote Tunnel (Site 3)			X	X	X
	Mainstem Santa Ynez River					
4	Bradbury Dam upstream of outlet structure	0	X	X	X	
5	Stilling Basin downstream of Hilton Creek		X		X	X
6	Long Pool	0.5	X	X	X	X
7	Santa Ynez River at San Lucas Ranch		X			
8	Santa Ynez River downstream of Santa Rosa Creek		X			
9	Santa Ynez River upstream of San Lucas Creek		X			
10	Santa Ynez River at Highway 154	2.9	X	X		
11	Refugio X	3.4			X	X
12	Refugio 17	6.0				X
13	Alisal Unit 48	7.8			X	
14	Alisal Unit 45	7.9				X
15	Alisal Unit 20	8.7			X	

[1] See Figure 3-1 for temperature monitoring locations within Cachuma Reservoir.

[2] See Figure 3-8 for temperature monitoring locations with the mainstem and tributaries.

Table 3-3 - Continued

Location Designation		Miles From Bradbury Dam	1993	1994	1995	1996
16	Alisal Unit 9	9.5			X	X
17	Santa Ynez River at Alisal Bridge (Solvang)	10.5		X	X	
18	Buellton	13.6		X	X	X
19	Weister Ranch	16.0				X
20	Cargasachi Ranch	24.0			X	X
21	Santa Ynez River at Lompoc			X		
22	Santa Ynez River upstream of Lagoon			X		
23	Lagoon Unit 1 - Upper Lagoon	46.5		X	X	X
24	Lagoon Unit 2 - Ocean Park	47.1			X	X
	Tributaries					
25	Lower Hilton Creek				X	
26	Hilton Creek - Shute				X	X
27	Nojoqui Creek upstream of Santa Ynez River				X	
28	Nojoqui Creek at Highway 101				X	X
29	Salsipuedes Creek downstream of Jalama Bridge		X			
30	Salsipuedes Creek upstream of El Jaro Creek				X	X
31	Salsipuedes Creek at Santa Rosa Bridge				X	X
32	El Jaro Creek				X	X

Table 3-4 Description of thermograph unit deployment location in the Santa Ynez River: 1995-1996.

Unit location by mile	Habitat unit width (ft)	Total Habitat length (ft)	Average Depth (ft)	Maximum depth (ft)	Date Measured[3]
Spill Basin mile 0.0[1]	500	700	3.5	5.0	1995
Long Pool mile 0.5[2]	129	1273	3.8	10.1	1995
Highway 154 mile 2.9					
Refugio X mile 3.4[2]	38	60	1.9	3.4	1995
Refugio 17 mile 6.0[2]	37	154	2.6	5.1	1996
Alisal 48 mile 7.9[2]	44	85	2.4	4.0	1995
Alisal 20 mile 8.7[2]	40	147	28	9.1	1995
Alisal 9 mile 9.5[2]	44	116	2.4	4.0	1995
Buellton mile 13.6[2]	35	95	2.0	3.5	1995
Wiester Ranch mile 16.0[2]	40	120	3.0	5.0	1996
Cargasachi Ranch mile 24.0[1]	52	270	1.0	3.4	1996
Lagoon #1 mile 46.5[1]	85	N/A	varied	varied	1995
Lagoon #2 mile 47.1[1]	170	N/A	varied	varied	1995

[1]Single thermograph deployed on bottom.
[2]Vertical array with one unit one foot below the surface, and the other on the bottom.
[3]Habitat characteristics where thermographs were deployed were measured typically during five surveys. Habitat characteristics are presented as average values for 1995. Habitat values for 1996 represent results of single surveys at each location.

Seasonal Trends in Water Temperature: 1993-1996

Average monthly, minimum, and maximum water temperatures have been compiled from available temperature records for various sampling stations over the period from 1993 to 1996. Data from these records, however, reflect a variety of factors. There is a general lack of continuity within the temperature records from one year to the next as recorders were either lost and data could not be retrieved, or sampling at stations was discontinued as recorders were relocated from one location to another. In addition, water temperatures were monitored over a wide range of environmental conditions including high flows during periods in 1993 and 1995 (spill from Cachuma Reservoir - see Section 2), and under controlled releases for both downstream water demand (WR 89-18) and fish reserve account releases. Water temperature recorders during this time period were located in areas which fluctuated in water depth substantially in response to instream flow conditions, with recorders in several locations being dewatered during portions of each year. Data from various recording locations is presented below to provide and overview of the historic water temperature information that is available from these early monitoring efforts.

Water temperatures within the spill basin, immediately downstream of Bradbury Dam, were monitored adjacent to the dam face in the vicinity of the outlet structure (Figure 3-10). Water temperatures were also measured at a location near the transition between the spill basin and Long Pool (Figure 3-11). The discontinuity in temperature monitoring results between 1994 and 1996 at the outlet structure was the result of a relocation of the temperature recorder to the downstream location. The limited temperature monitoring data that are available for these two locations showed that variation between monthly minimum and maximum water temperatures are substantially smaller immediately adjacent to the outlet structure (Figure 3-10), when compared to the location further downstream within the spill basin (Figure 3-11). A similar pattern of increasing variation between monthly minimum and maximum water temperatures occurs along the longitudinal gradient within the mainstem Santa Ynez River, extending downstream of the spill basin. Summer water temperatures within the lower reach of the spill basin (Figure 3-11) were substantially higher during 1994 when compared with 1995 reflecting, in part, differences in flow conditions and reservoir storage between these two years (Section 2). Average and maximum air temperature measured at the Santa Ynez Airport (Table 3-1; Figure 3-1) did not show a consistent pattern of differences during the summer months between 1994 and 1995.

Water temperature monitoring at the surface within the Long Pool has been conducted intermittently since 1993 (Figure 3-12). As a result of the inconsistent temperature records, however, inter-annual variability in water temperatures cannot be determined for this location.

Water temperature was monitored at the Highway 154 Bridge (2.9 miles downstream of Bradbury Dam) during 1993 and 1994 (Figure 3-13). During the summer months in 1994 the temperature recorder was dewatered, resulting in a discontinuity within the dataset (Figure 3-13).

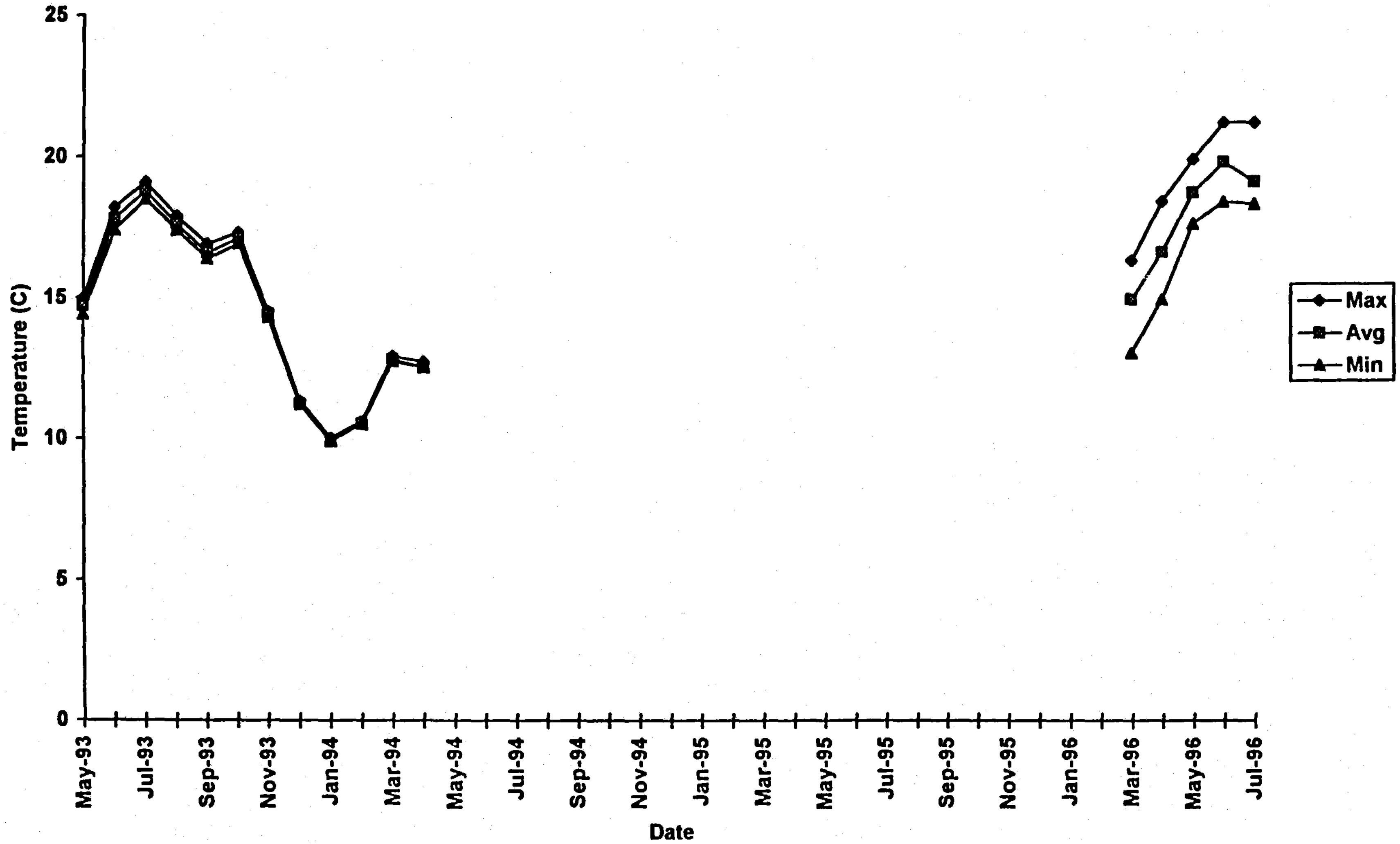


Figure 3-10. **Average monthly, minimum, and maximum water temperatures measured within the Spill Basin immediately downstream of Bradbury Dam: 1993-1996.**

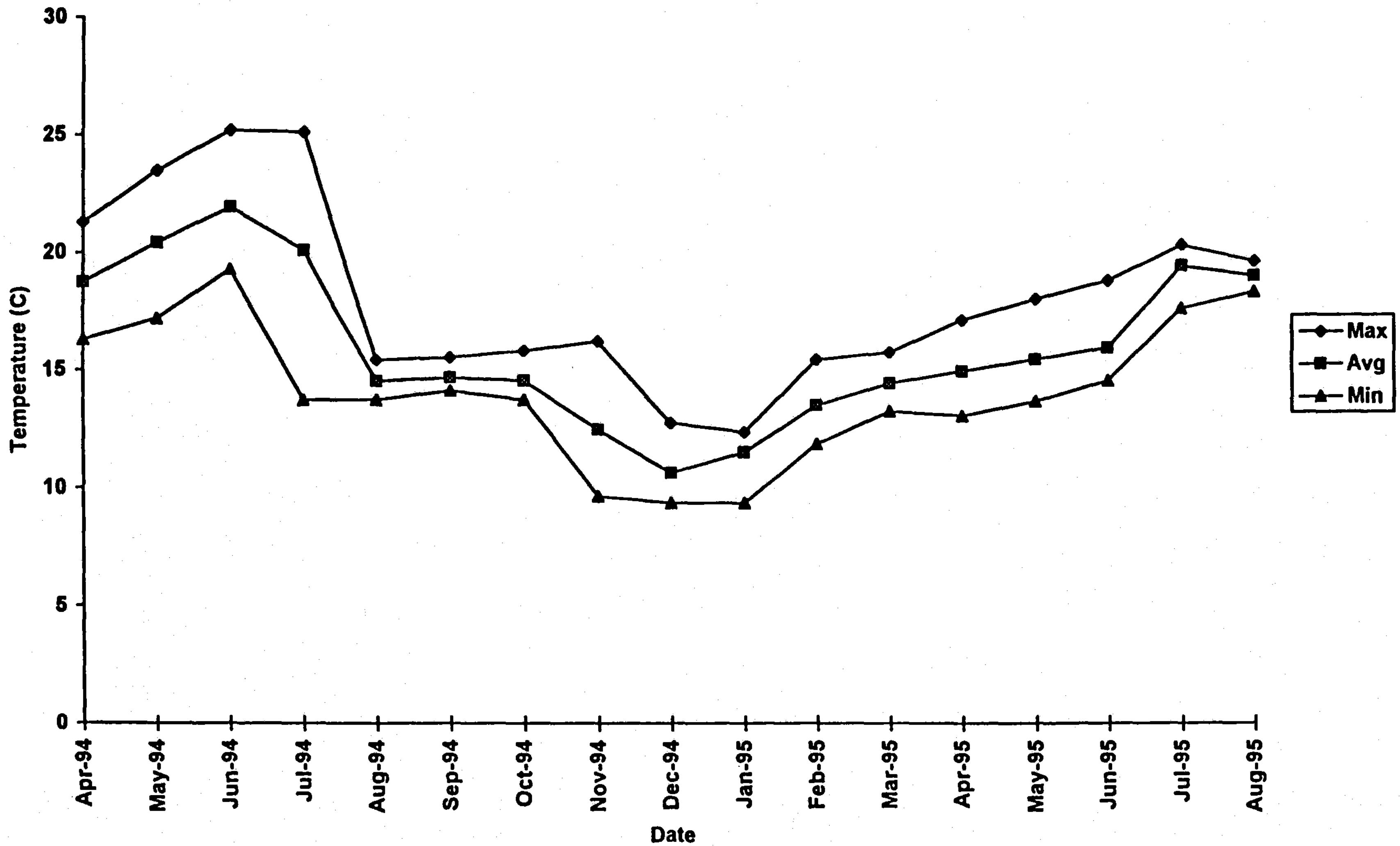


Figure 3-11. Average monthly, minimum, and maximum water temperatures measured at the Spill Basin tailout: 1994-1995.

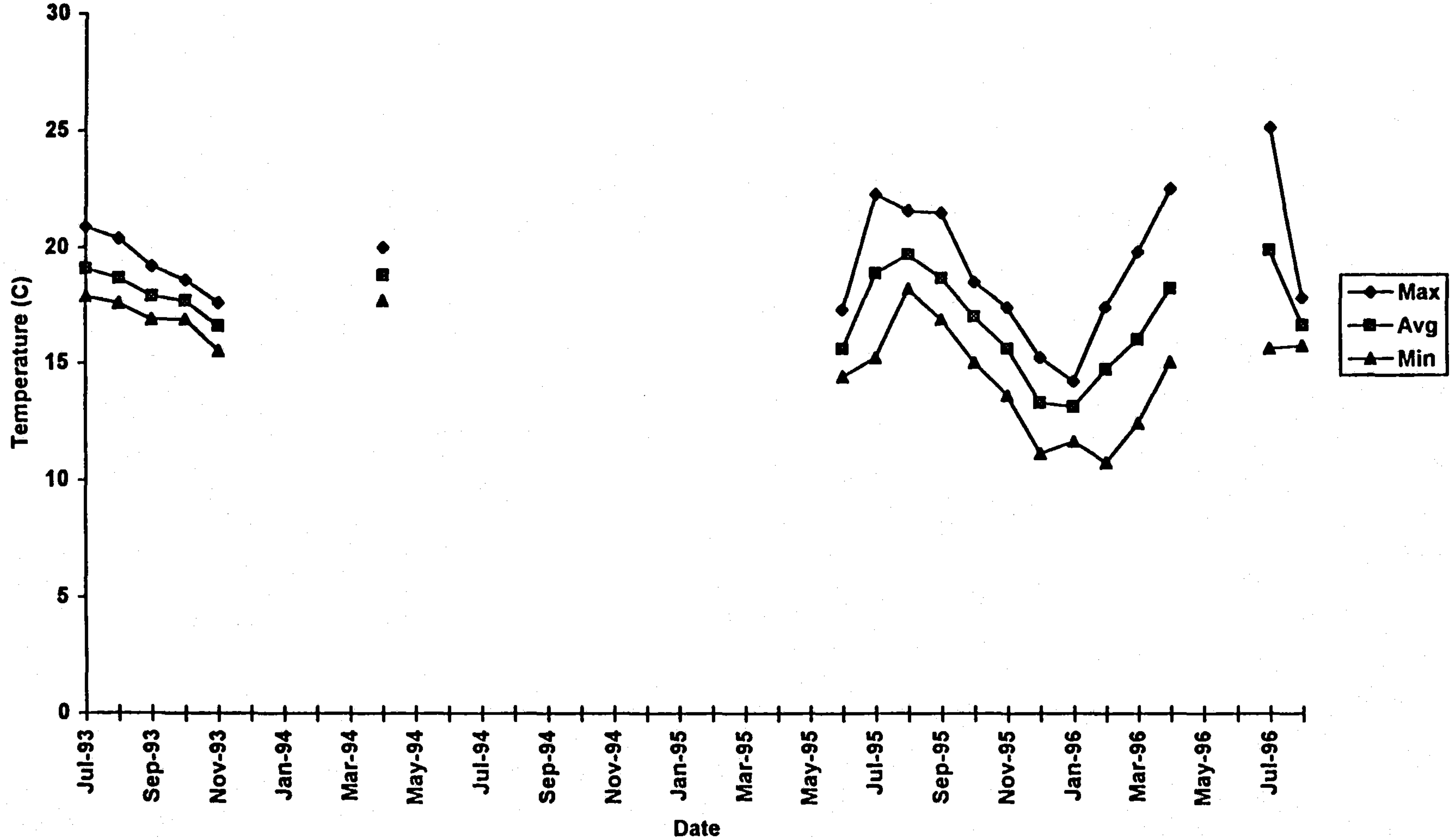


Figure 3-12. Average monthly, minimum, and maximum water temperatures measured within the Long Pool (surface): 1993-1996.

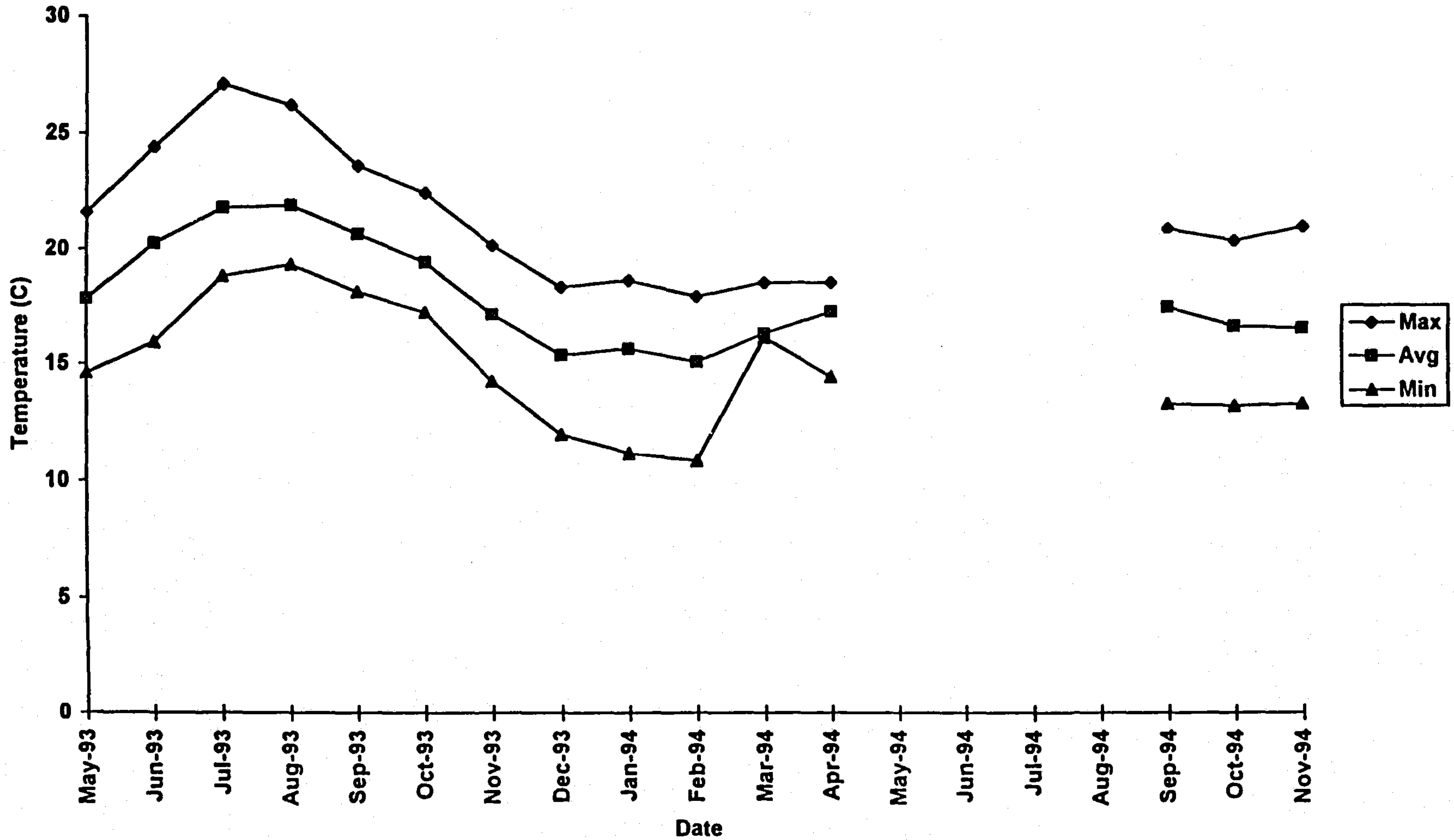


Figure 3-13. **Average monthly, minimum, and maximum water temperatures measured at the Highway 154 Bridge (2.9 miles downstream of Bradbury Dam): 1993-1994.**

Water temperature monitoring was also conducted periodically at the Alisal Road Bridge, (10.5 miles downstream of Bradbury Dam), during the period from 1993 through 1995 (Figure 3-14). The intermittent temperature record for this location reflects the loss of temperature recorders due to high flows, vandalism, and recorders being buried by deposited sediments. In addition, fluctuating water levels resulted in temperature recorders becoming dewatered during the monitoring period.

Water temperature monitoring has been conducted intermittently at Buellton (13.6 miles downstream of Bradbury Dam), between 1993 and 1996 (Figure 3-15). As with other locations, the lack of continuity within the temperature record for Buellton prohibits meaningful analysis of inter-annual variability in water temperatures.

Data collected from various locations within the mainstem Santa Ynez River during 1993 (Figure 3-16) are consistent with results of later monitoring in demonstrating a longitudinal gradient in water temperatures, with increasing temperature as a function of distance downstream of the dam. Flows within the mainstem Santa Ynez River during the summer of 1993 are reflected in results from the USGS gauging station at Solvang (Appendix B), where July flows averaged 9.6 cfs, with a range from 5 to 14 cfs, August flows averaged 3.1 cfs, with a range from 0 to 6.2 cfs, and September flows averaged 0.3 cfs, with a range from 0 to 3 cfs. Results of the longitudinal gradient in water temperature observed during the 1993 are further discussed in the section, "Longitudinal Temperature Gradient".

Results of limited water temperature monitoring within the mainstem Santa Ynez River during the winter and spring of 1994 are shown in Figure 3-17. Results of the 1994 monitoring are also consistent in showing a substantial increase in water temperatures, even during the winter and early spring, from Bradbury Dam to the Highway 154 (San Lucas Highway) Bridge.

Water temperatures were also measured within Salsipuedes Creek during the spring, summer, and early fall of 1993, at a location downstream of Jalama Bridge. Results of this water temperature monitoring (Figure 3-18) show maximum daily temperatures exceeding 25 C, with average daily summer temperatures occurring above 20 C. Flows measured within Salsipuedes Creek downstream near the confluence with the Santa Ynez River near Lompoc (Appendix B), showed average monthly flows in May of 7.6 cfs (6.9 - 8.7), average flows in June of 4.3 cfs (3.3 - 5.3), average flows in July of 2.7 cfs (1.7 - 3.5), with average flows in August, September, and October being 1.4, 1.3, and 1.3 cfs, respectively.

Seasonal Pattern: 1995-1996

Seasonal trends in water temperature within the Santa Ynez River mainstem downstream of Bradbury Dam have been documented at various monitoring locations (Figure 3-9). The most intensive and complete water temperature monitoring occurred during 1995-1996, which included monitoring at locations along the Santa Ynez River at both surface and bottom locations where water depth permitted (Table 3-4). Beginning in 1995, Optic

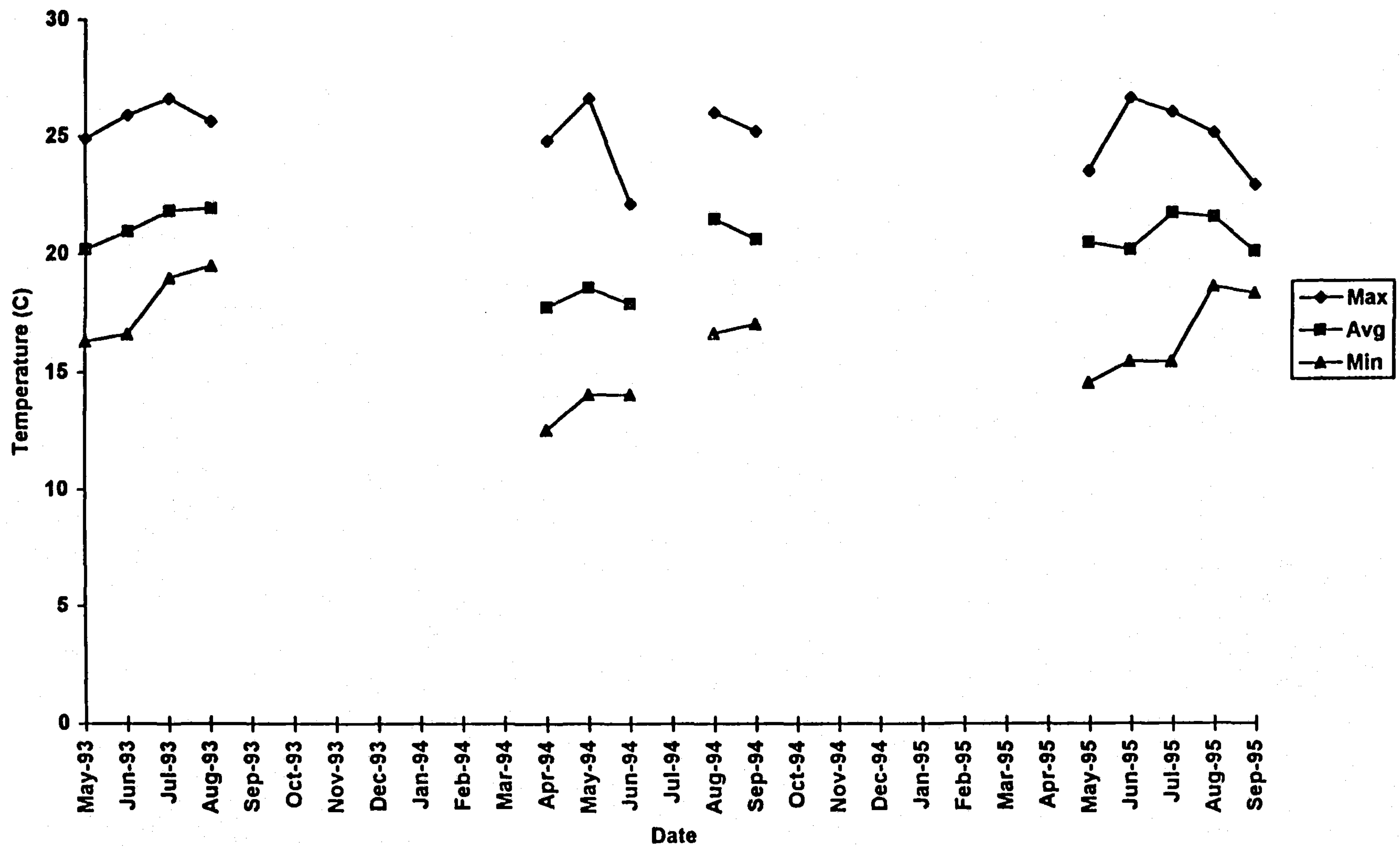


Figure 3-14. **Average monthly, minimum, and maximum water temperatures measured within the Santa Ynez River mainstem at the Alisal Bridge (10.5 miles downstream of Bradbury Dam): 1993-1995.**

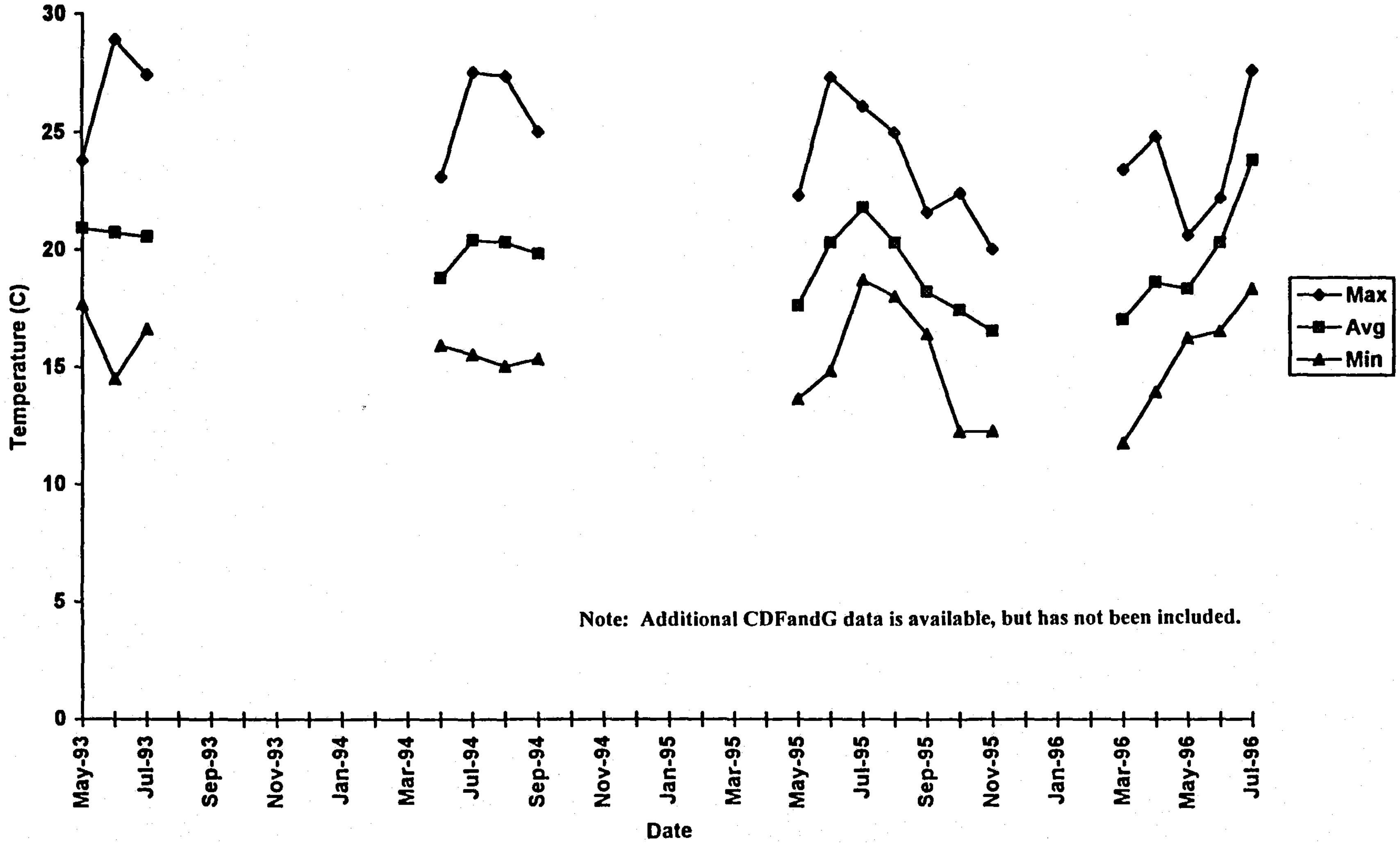


Figure 3-15. **Average monthly, minimum, and maximum water temperatures measured within the Santa Ynez River mainstem at Buellton (13.6 miles downstream of Bradbury Dam): 1993-1996.**

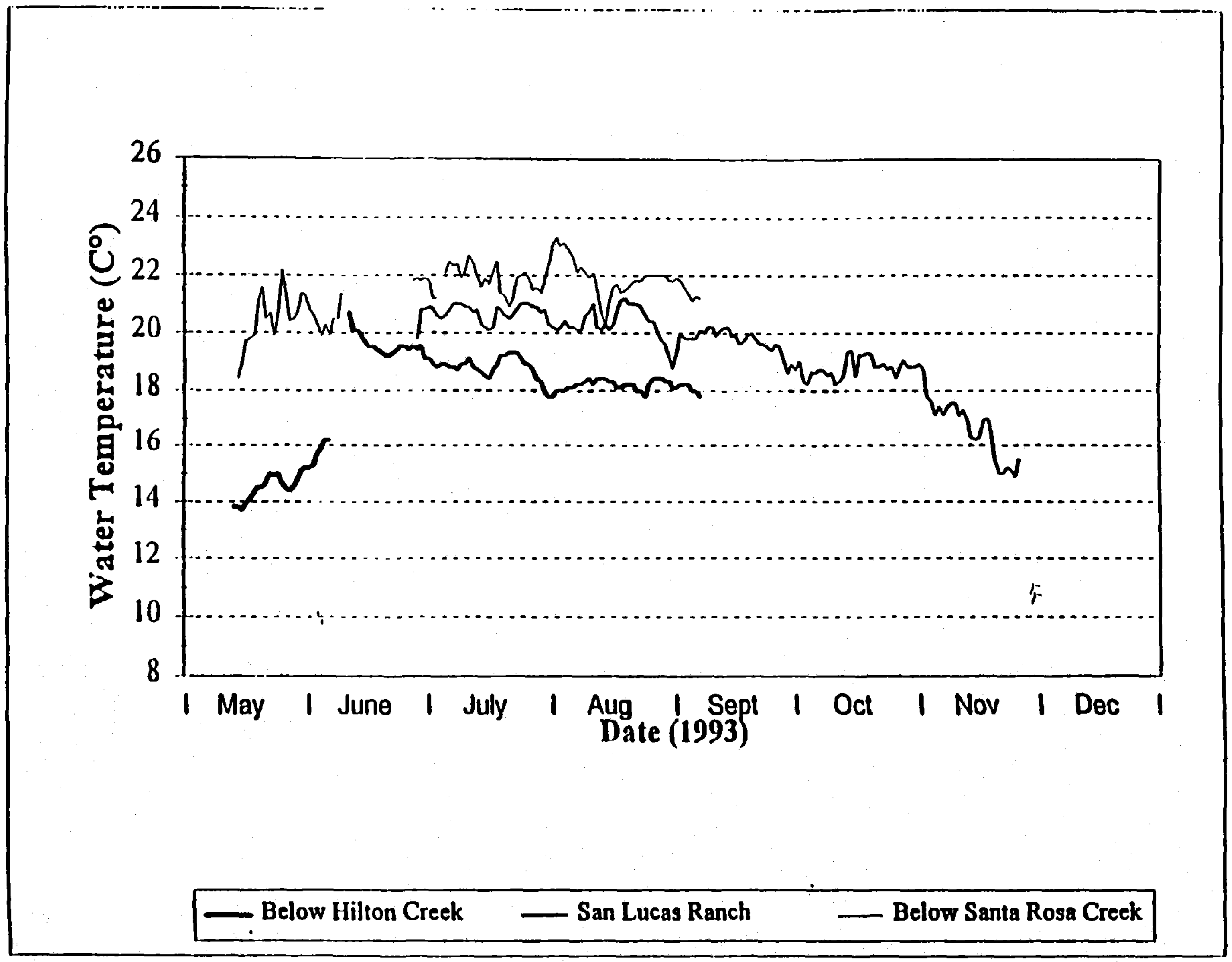


Figure 3-16. Water temperatures measured in the Santa Ynez River mainstem below Hilton Creek, San Lucas Ranch, and Santa Rosa Creek, during 1993. (Source: CDFandG, unpublished data).

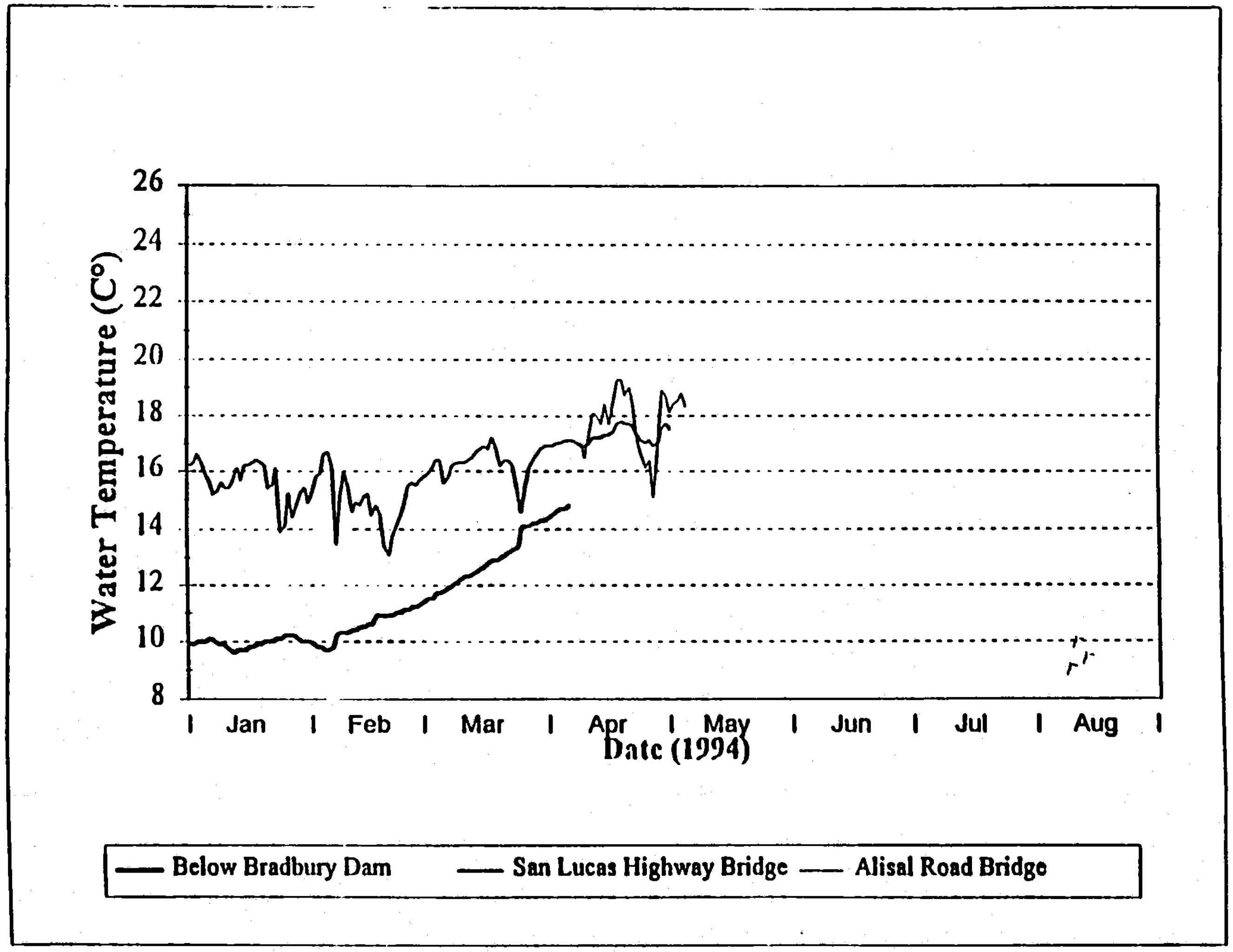


Figure 3-17. Results of water temperature monitoring within the Santa Ynez River below Bradbury Dam, Highway 154 (San Lucas) Bridge, and Alisal Road Bridge during 1994. (Source: Entrix, 1995).

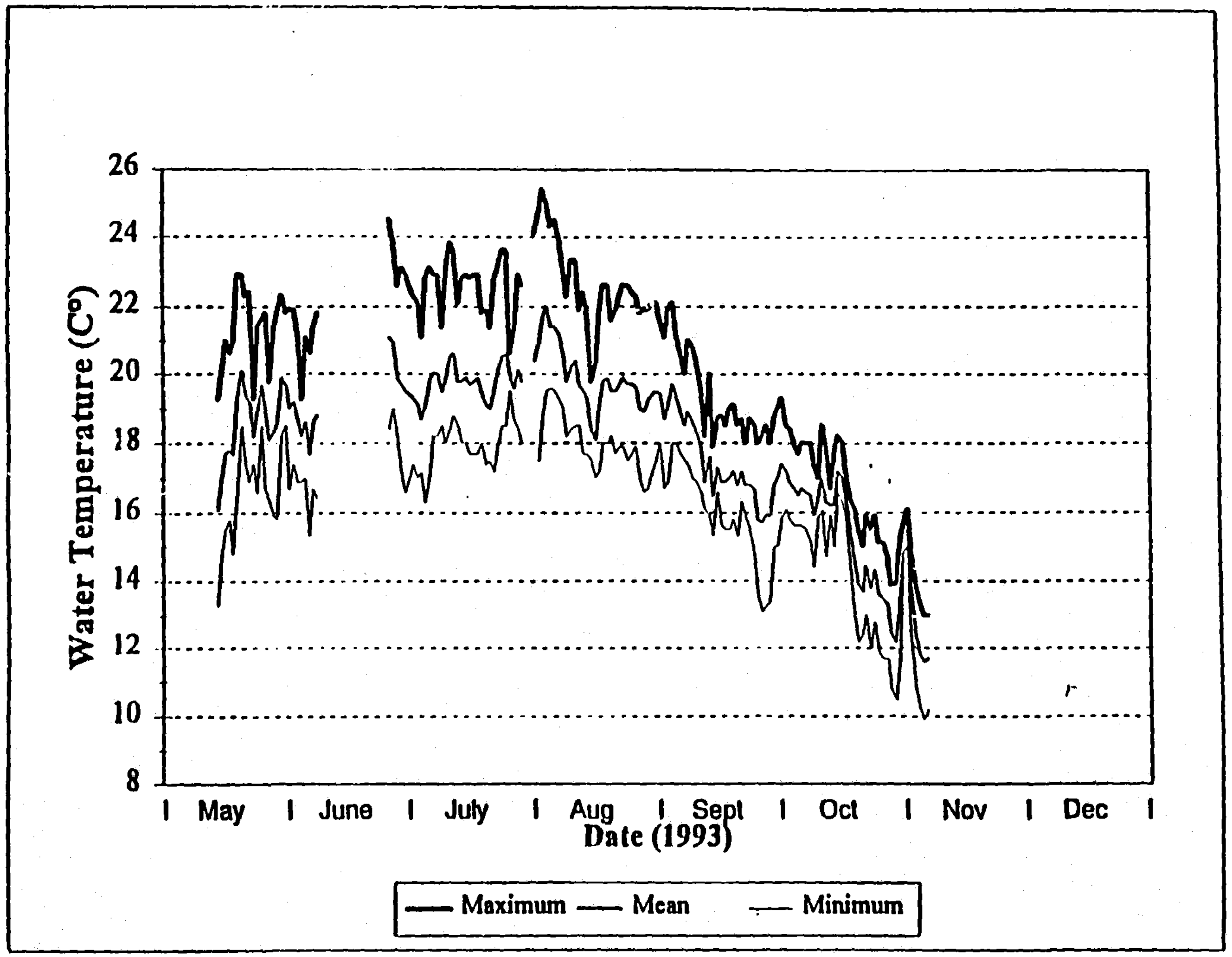


Figure 3-18. **Average daily, minimum, and maximum water temperatures measured within Salsipuedes Creek downstream of Jalama Bridge during 1993. (Source: CDFandG, unpublished data).**

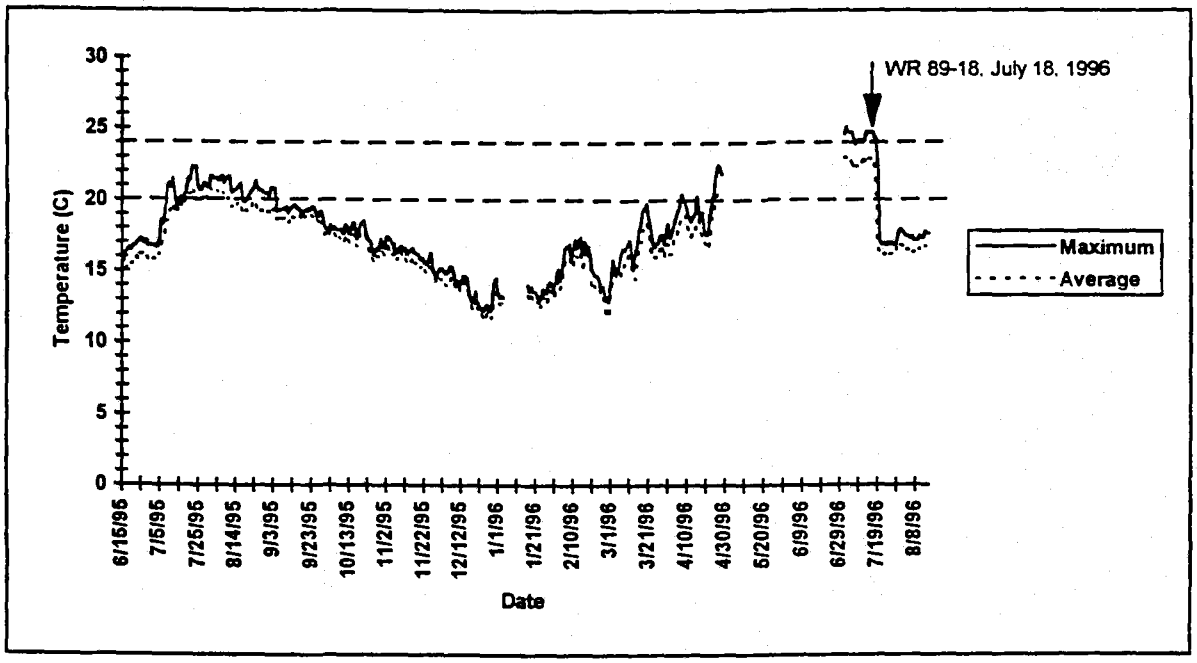
Stowaway thermographs set to record hourly temperatures 24-hours a day were used to record water temperature within the mainstem river and tributaries. Thermographs were deployed primarily as vertical arrays in pool and run habitats between May 4 and July 24, 1995, and have continued to be monitored through 1996. Some thermographs were removed from the mainstem and tributaries prior to the rainy season to prevent losing units in high flows. Most temperature monitoring units were re-deployed in the same locations beginning in March and April 1996, however several units were relocated to avoid areas of high public use and potential vandalism.

Currently there are 22 thermographs deployed in the mainstem and tributaries (Figure 3-9). In non-vertical array locations, thermographs in 1995 were attached to T-posts pounded approximately 2 feet into the substrate with the temperature unit attached approximately 4 inches above the substrate. In vertical array locations, a two pound weight attached to a nylon cord with a float on top is used to keep the thermograph vertical in the water column. One thermograph was attached to the base of the nylon cord approximately 4 inches above the substrate and the other was attached approximately one to two feet below the water surface. Beginning in November and December 1995, all thermographs were placed in small metal pipe enclosures which allowed free flow of water and protection from debris during high flows. The pipe enclosures were attached to ¼-inch steel cables, which in turn were attached to nearby trees. Floats were attached to those units which were suspended in the water column.

Long Pool

Results of water temperature monitoring within the Long Pool (located 0.5 miles downstream of Bradbury Dam), during the period from mid-June 1995 through mid-August 1996, are shown for surface and bottom monitoring locations in Figure 3-19. Water temperatures show a typical seasonal pattern of warming during the spring and summer, followed by cooling during the fall and winter. Average daily summer water temperatures were up to 21 C in 1995 and 24 C in 1996 at the surface, but were 20 C or less at the bottom. Variation between the average daily water temperature and maximum daily temperature was typically less than 1 C during the winter, and 1-2 C during the summer at the surface recorder. Variation between the average daily water temperature and maximum daily temperature at the bottom recording location (Figure 3-19) was consistently less than 1 C, with substantially lower seasonal variation than that observed at the surface recorder.

Although average daily temperatures were typically lower near the bottom of the Long Pool when compared with surface observations, the difference in temperature was less than 1 C throughout the monitoring period from June through December, 1995. In 1996, however, before WR 89-18 releases were initiated, significant temperature stratification occurred in the Long Pool (Figure 3-19), resulting in a 3-7 C difference between surface and bottom temperatures. Maximum daily water temperature within the Long Pool was typically greatest near the surface, where maximum daily surface temperature exceeded maximum daily bottom temperature by 1-2 C during the summer, and by less than 1 C during the fall and winter. Temperature differences between the surface and bottom



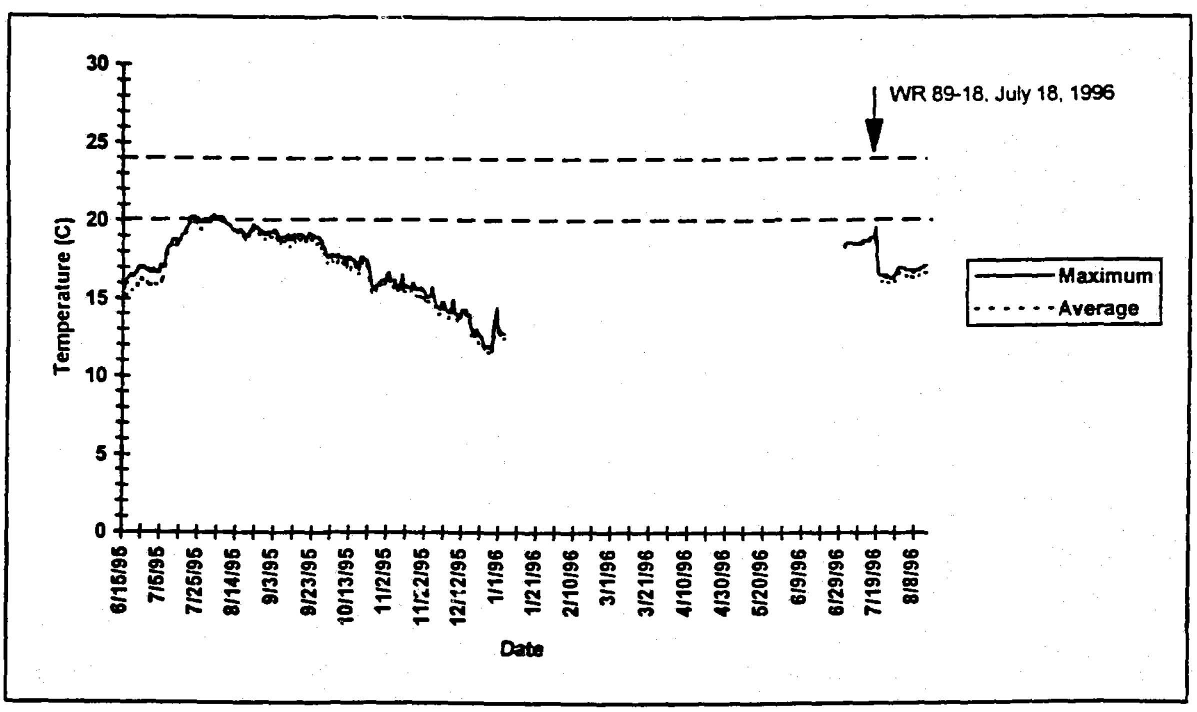


Figure 3-19. Daily average and maximum surface (Upper Panel) and bottom (Lower Panel) water temperatures measured in the Long Pool (located 0.5 miles downstream of Bradbury Dam).

within the Long Pool were as large as 5 C following the beginning of 1996 WR 89-18 releases.

During July, 1996, controlled releases were made from Bradbury Dam (WR 89-18 releases at a rate of 135 cfs began July 18, 1996; see Section 2) during which time water temperatures measured near the bottom of the Long Pool were approximately 2 C lower than surface temperatures (Figure 3-20). Both surface and bottom water temperatures showed a rapid decrease coincident with the WR 89-18 releases.

Refugio Reach

Average and maximum daily water temperature measured at the Refugio Habitat Unit X, located 3.4 miles downstream of Bradbury Dam (Figure 3-9), are shown in Figure 3-21 for monitoring during the period from mid-June through mid-November, 1995. Average daily summer temperatures at the surface typically ranged from 20-24 C, with maximum temperatures exceeding 26 C. These surface water temperatures, although highly variable both within and between days, did not show a pronounced declining pattern during the fall, as was observed in the Long Pool and other monitoring locations downstream of mile 3.4. Surface water temperature at the Refugio habitat was typically higher when compared with temperatures at the Long Pool, and was characterized by substantially greater variation between average daily and maximum daily water temperatures throughout the summer and fall than was observed further upstream.

The temperature monitor was relocated from the surface to the bottom at the Refugio Habitat Unit X during December, 1995, when monitoring continued through April, 1996 (Figure 3-21). Average daily bottom temperatures were consistently less than 20 C, although maximum daily temperatures did exceed 25 C. Bottom water temperatures showed a general increasing trend for both average daily and maximum daily water temperatures during the spring. During the spring, variation between the average daily to maximum daily temperature was up to 6 C.

Surface water temperatures were monitored at the Refugio Habitat Unit 17 (Figure 3-9), located six miles downstream of Bradbury Dam, from late May through early July, 1996. Water temperature monitoring was performed at both the surface (Figure 3-22) and bottom (Figure 3-22). Variation between average daily and maximum daily water temperatures was substantially larger (1-3 C) at the surface when compared to the bottom monitoring location (less than 1 C). Average daily surface temperature was typically 1-2 C greater than the corresponding bottom temperature during the monitoring period.

Monitoring at the Refugio Habitat Unit 17, however, was insufficient in duration to characterize seasonal trends and patterns in water temperature conditions at this location.

Results of fishery surveys confirmed that rainbow trout/steelhead inhabited both Refugio Habitat Unit X and Unit 17 throughout 1995.

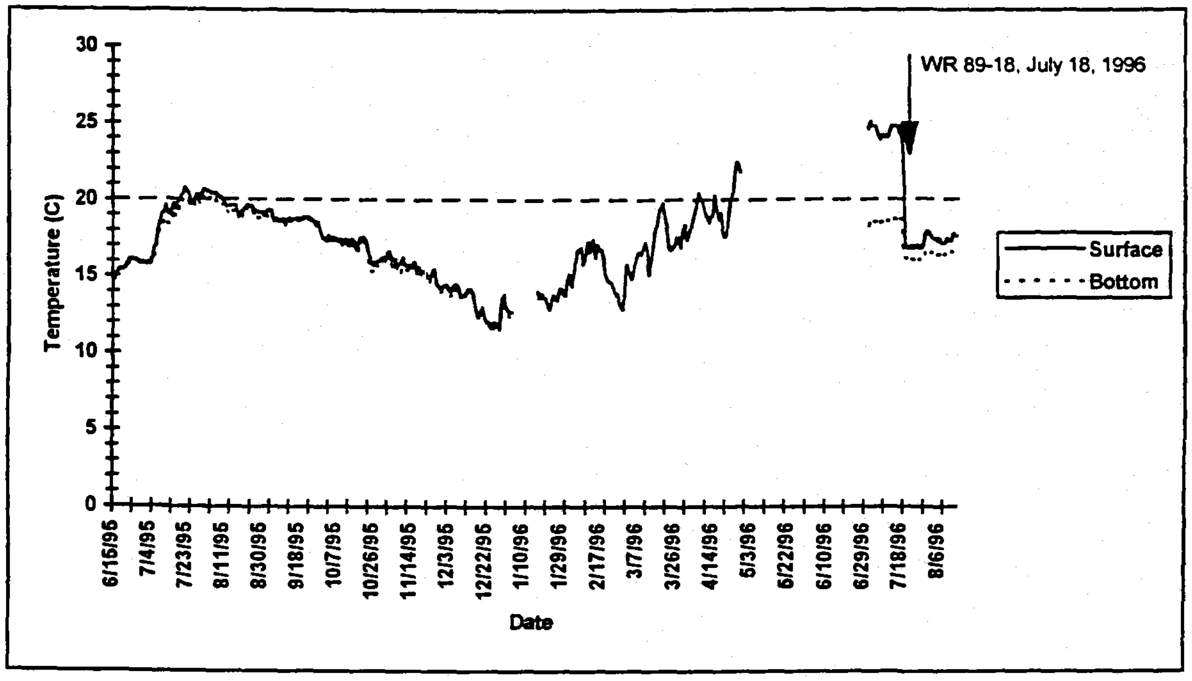
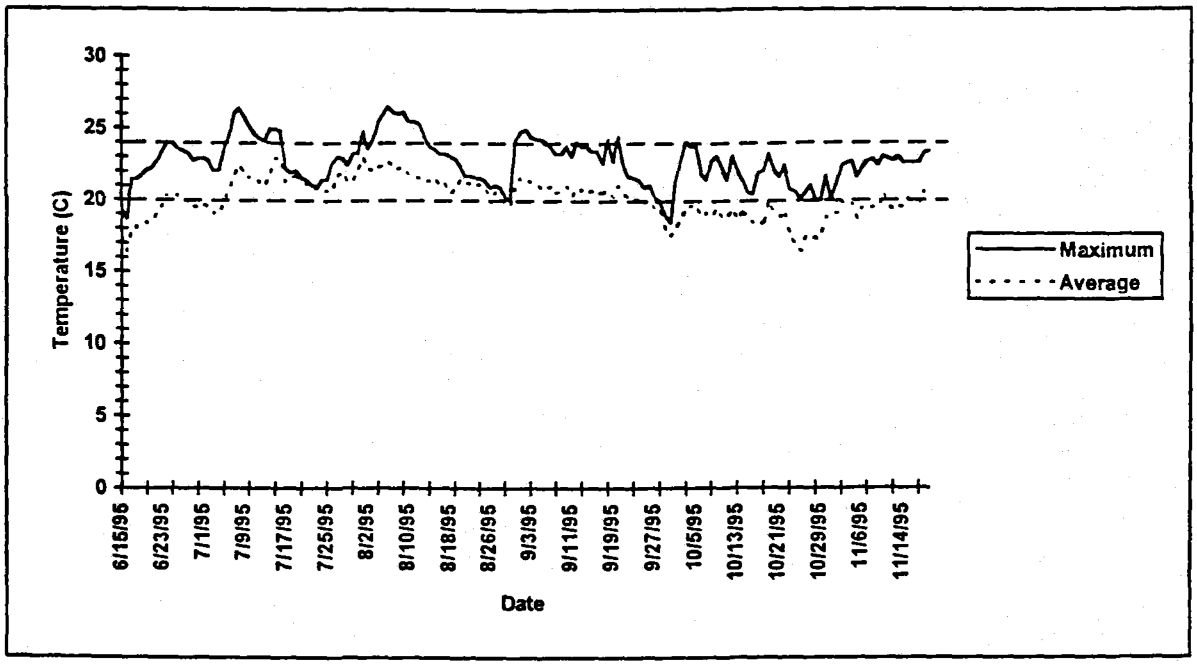


Figure 3-20. **Comparison of average daily water temperatures at the surface and bottom within the Long Pool (located 0.5 miles downstream of Bradbury Dam).**



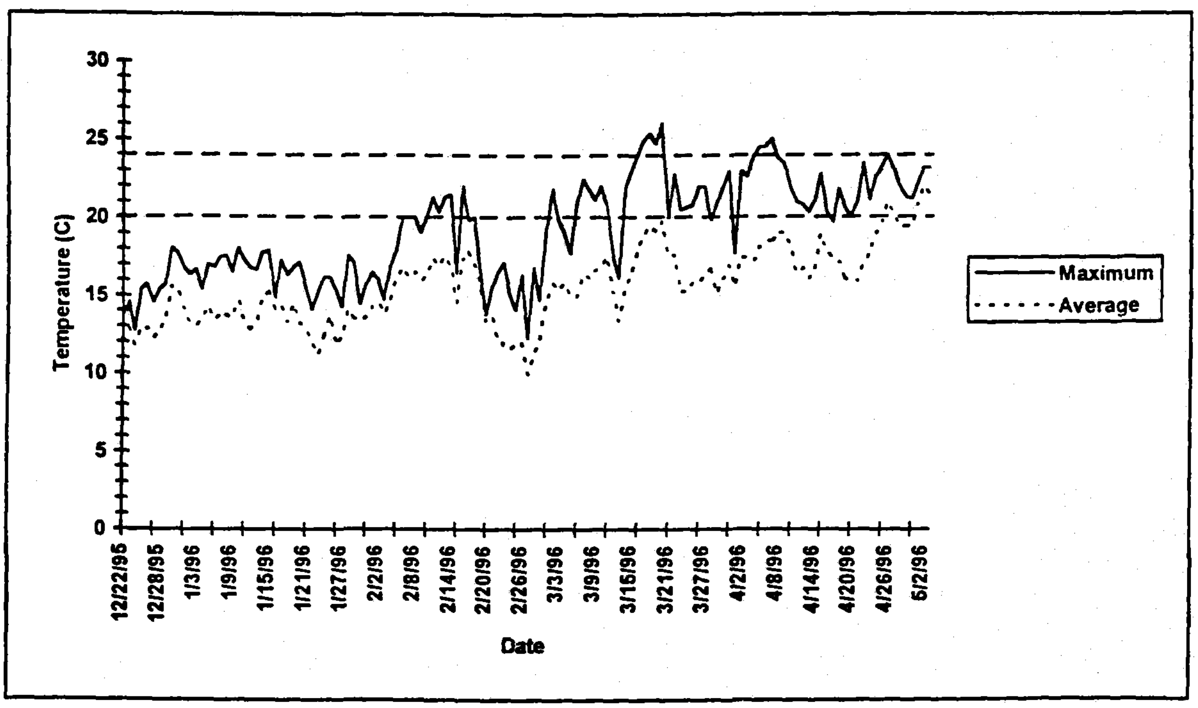
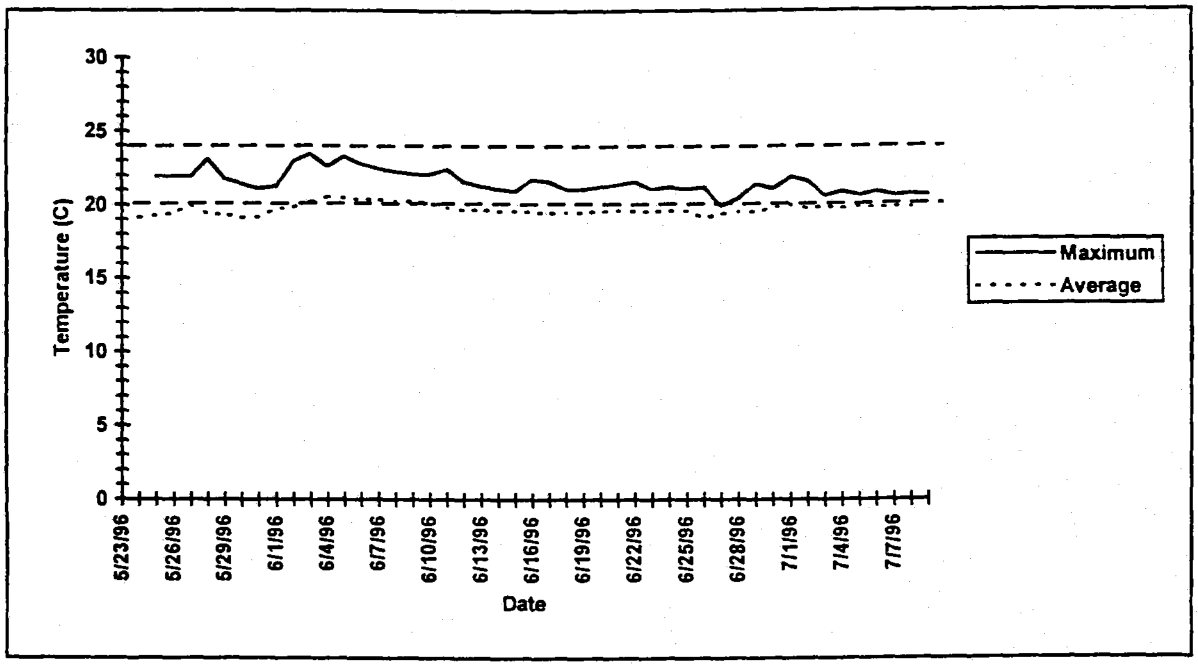


Figure 3-21. Average daily and maximum surface (Upper Panel) and bottom (Lower Panel) water temperatures at Refugio Habitat Unit X (located 3.4 miles downstream of Bradbury Dam).



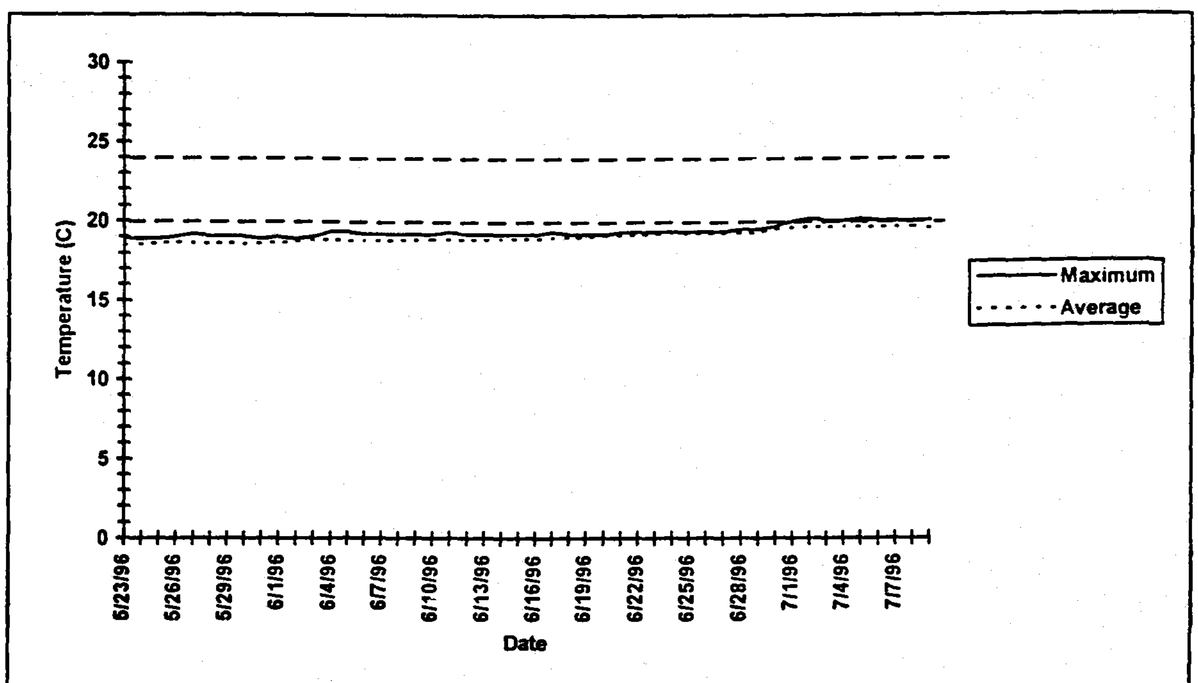


Figure 3-22. **Average daily and maximum surface (Upper Panel) and bottom (Lower Panel) water temperatures at Refugio Habitat Unit 17 (located 6.0 miles downstream of Bradbury Dam).**

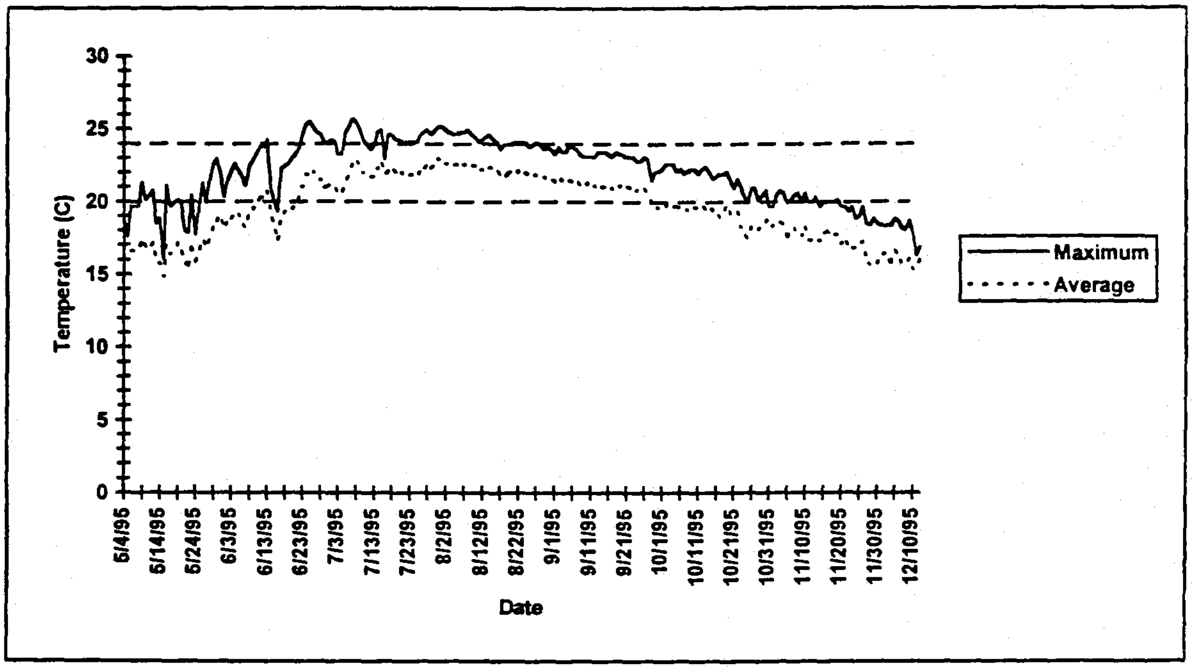
Alisal Reach

Water temperature monitoring at Alisal Habitat Unit 48 (7.8 miles downstream of Bradbury Dam) was conducted from early May through mid-December, 1995 (Figure 3-23). Average daily water temperature at both the surface and bottom recording locations ranged from 20-23 C throughout the period from late June through September. Maximum surface water temperatures during the summer were typically 24-25 C, with maximum daily temperatures as high as 26 C, observed periodically during the summer. Maximum daily water temperatures at the bottom were typically 1-3 C lower than temperatures occurring near the surface. Despite the relatively high average daily and maximum water temperatures recorded, rainbow trout/steelhead were observed at this habitat location (Section 5), and were able to survive oversummering conditions in 1995. Water temperature monitoring units deployed at Alisal Habitat Unit 48 during 1995 were re-deployed at a location 7.9 miles downstream of Bradbury Dam (Alisal Habitat Unit 45) during 1996.

Water temperatures monitored near the bottom at the Alisal Habitat Unit 45 (Figure 3-9) located 7.9 miles downstream of Bradbury Dam, are shown in Figure 3-15 for the period mid-December, 1995 through mid-August, 1996. Water temperature was relatively consistent throughout the monitoring period, with the exception of a sudden short-term decline in water temperatures between mid-February and mid-March, 1996. Variation between average daily and maximum daily bottom water temperature was greatest during April, 1996, followed by a substantial reduction in daily variation during May and June. Average daily water temperatures were less than 20 C from mid-December, 1995 through June, 1996. Average daily bottom temperature exceeded 20 C on 6 days in July and 5 days during monitoring in early August, 1996. Maximum daily temperature was 24.7 C in July, 1996. Average daily and maximum daily water temperatures increased in late July, 1996. The maximum daily bottom temperature was observed to increase substantially (up to 4 C) above the average daily temperature following the controlled WR 89-18 release from Bradbury Dam, which occurred beginning in July, 1996 (Figure 3-24). Variation in maximum daily temperature between days also increased after the WR 89-18 releases began.

Water temperatures were measured at the surface at the Alisal Habitat Unit 45 (Figure 3-24), from May through early-July, 1996. During this monitoring period, average daily and maximum daily water temperatures were consistently below 20 C. Maximum daily surface temperature recorded at Alisal Habitat Unit 45 was 20.4 C in May, with maximum daily temperatures less than 20 C recorded in June and early July, 1996. The limited period of surface water temperature monitoring precludes a detailed evaluation of differences between surface and bottom water temperatures at Habitat Unit 45.

Surface and bottom water temperature monitoring was conducted during 1995 at Alisal Habitat Units 20 (Figure 3-25) and 9 (Figure 3-26). Four rainbow trout/steelhead were observed at Habitat Unit 9 during August-October, 1995. Rainbow trout/steelhead were also present in Habitat Unit 20 during 1996 surveys (Section 5), coincident with very little surface algae. Comparison of daily variation in surface and bottom water



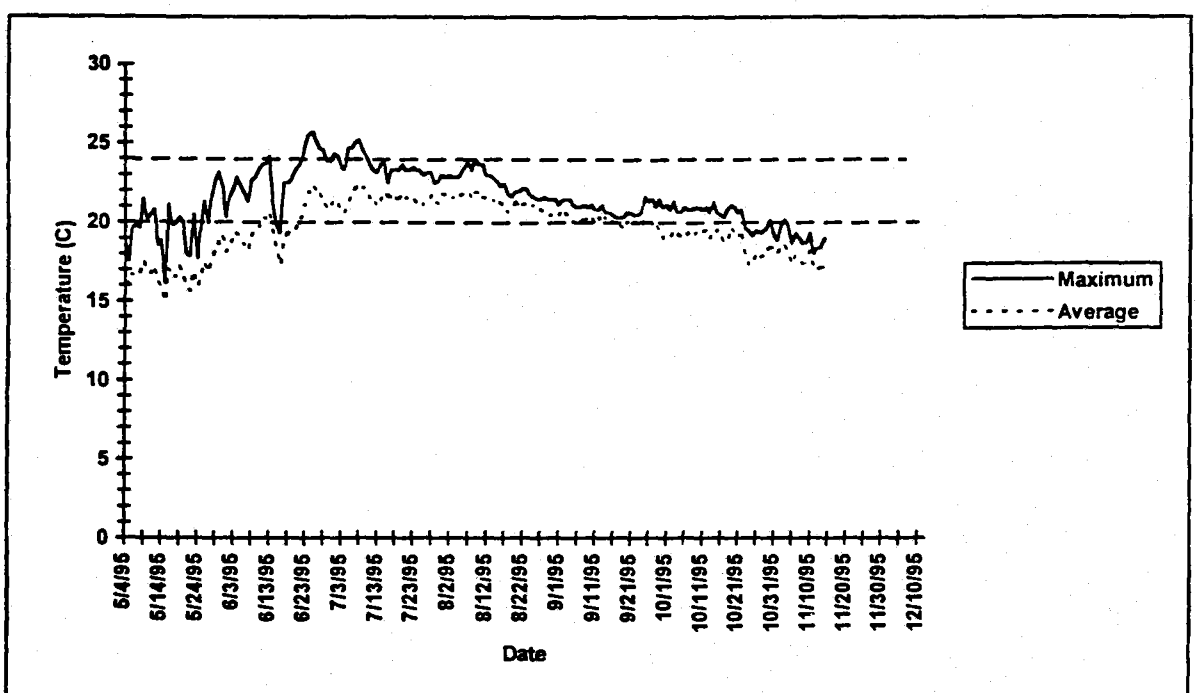


Figure 3-23. Average daily and maximum surface (Upper Panel) and bottom (Lower Panel) water temperatures at Alisal Habitat Unit 48 (located 7.8 miles downstream of Bradbury Dam).

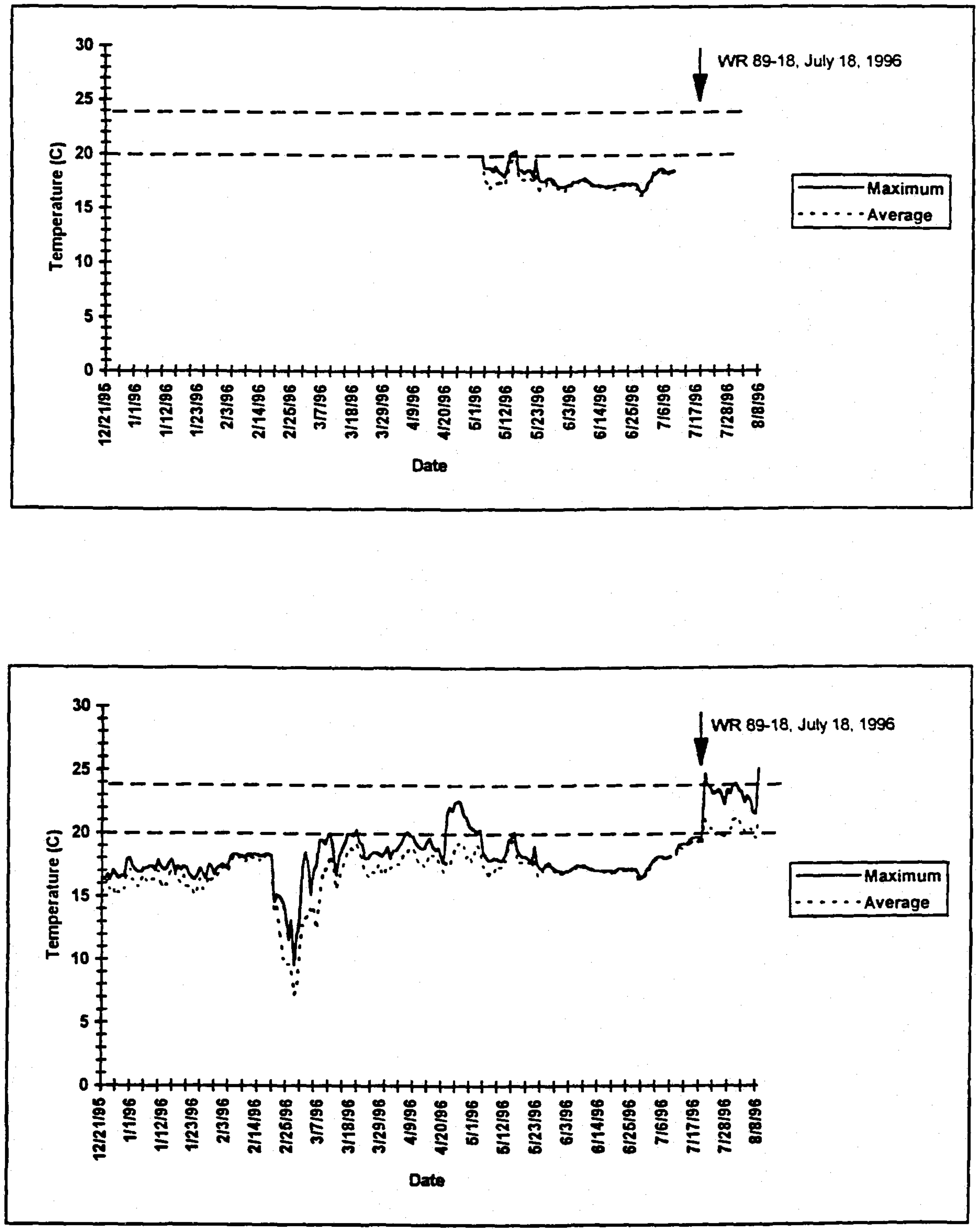
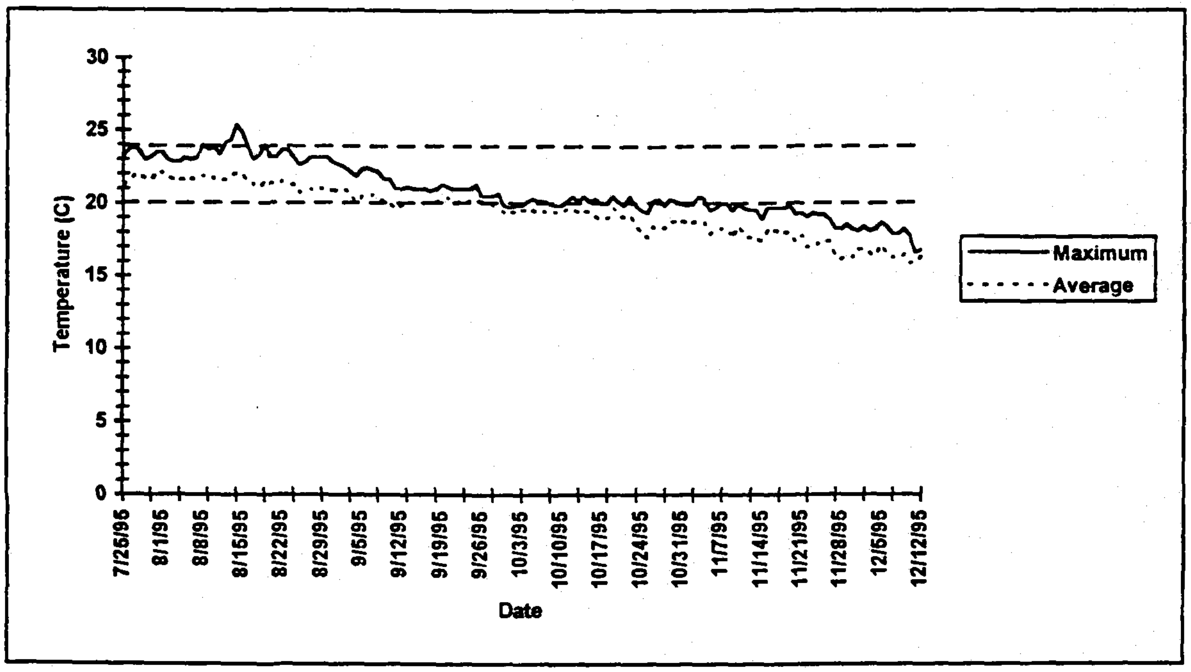


Figure 3-24. Average daily and maximum surface (Upper Panel) and bottom (Lower Panel) water temperatures at Alisal Habitat Unit 45 (located 7.9 miles downstream of Bradbury Dam).



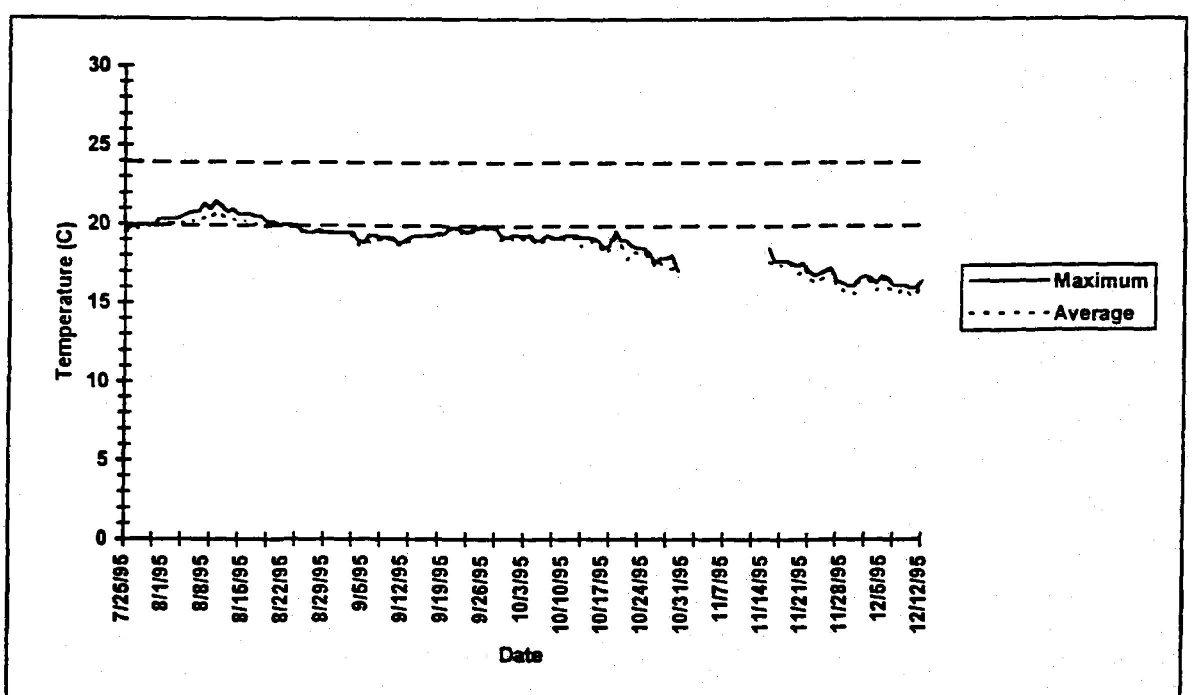


Figure 3-25. Average daily and maximum surface (Upper Panel) and bottom (Lower Panel) water temperatures at Alisal Habitat Unit 20 (located 8.7 miles downstream of Bradbury Dam).

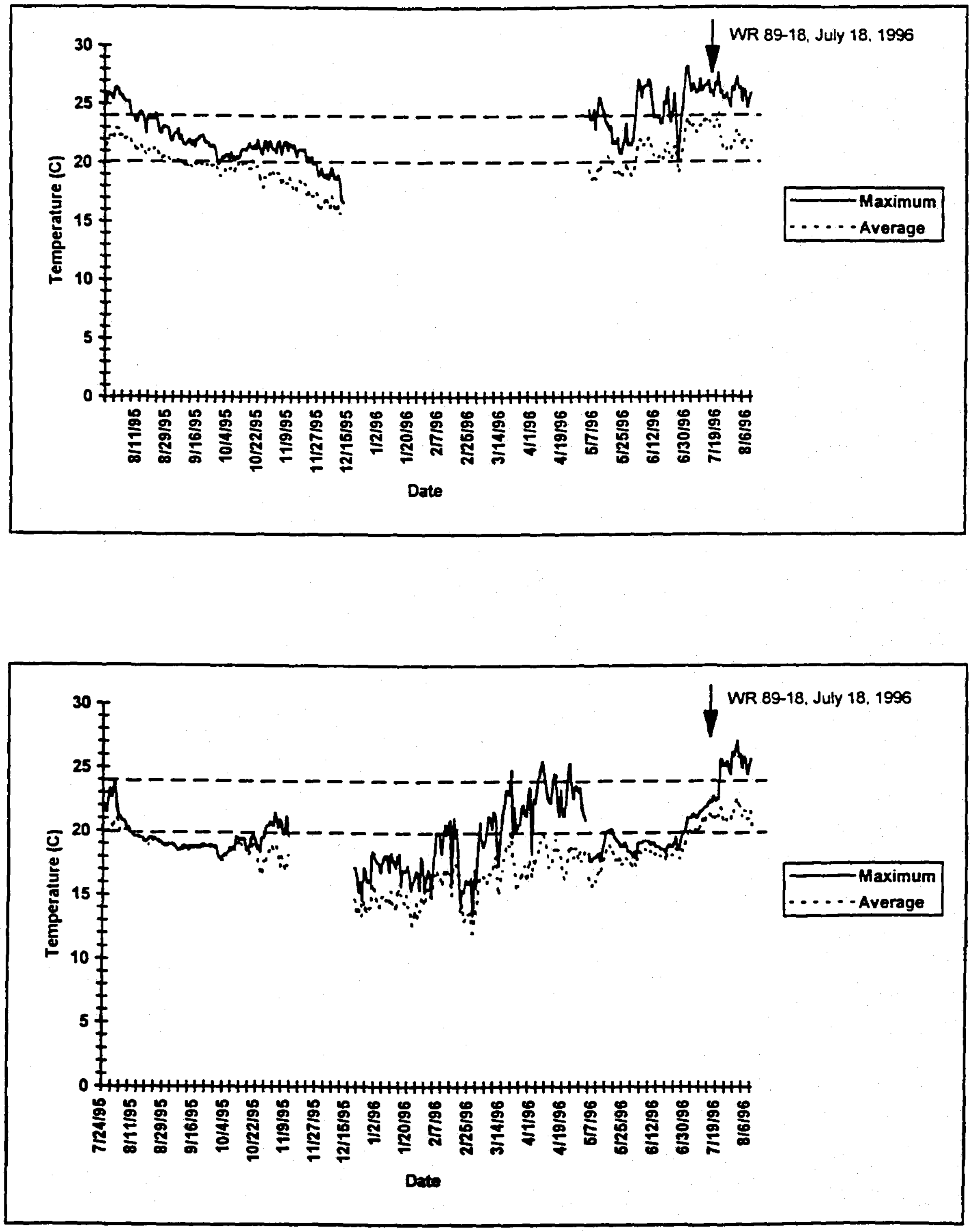


Figure 3-26. Average daily and maximum surface (Upper Panel) and bottom (Lower Panel) water temperatures at Alisal Habitat Unit 9 (located 9.5 miles downstream of Bradbury Dam).

temperatures at Habitat Unit 9 during 1996 (Figure 3-26) provided evidence that water temperatures within the habitat units were vertically stratified, with colder more consistent temperatures near the bottom, prior to the WR 89-18 release, or that cool groundwater upwelling occurred in the area which contributed to the lower, more stable, water temperatures observed near the bottom. Bottom water temperatures monitored at the Alisal Habitat Unit 9 (Figure 3-9) located 9.5 miles downstream of Bradbury Dam, are shown in Figure 3-26 for monitoring during the period from mid-July, 1995 through mid-August, 1996. Water temperatures at this location varied within a day by up to 5 C during the spring (March-April, 1996), followed by a substantial reduction in the daily temperature variation observed during May and June. Flows during March-April ranged from 1 to 100 cfs at the Santa Ynez gauge, with the highest flows in March (Appendix B). Flow, measured at the Santa Ynez gauge (Appendix B) was stable at a rate of 0.8 cfs through May and into early June. Daily variation in temperature was observed to increase beginning in mid-July, 1996 coincident with controlled WR 89-18 releases from Bradbury Dam. In general, the 1996 WR 89-18 flow releases resulted in the loss of thermal stratification within deeper pools, increases in daily variation at several locations, and increases in both average daily and maximum daily water temperatures at several downstream locations. Additional data and analyses would be required to further evaluate this apparent trend.

Comparison of surface and bottom temperatures at Alisal Habitat Unit 9 (Figure 3-26) showed that surface temperatures were consistently higher than bottom temperatures. Average daily surface temperature exceeded 20 C during water temperature monitoring in August, 1995, and June-August, 1996. Maximum daily temperatures exceeded 25 C during the summer months in 1996 at the surface, both before and after WR 89-18 releases. Maximum temperatures during the summer were less than 25 C at the bottom prior to the WR 89-18 releases, but increased following initiation of the release, resulting in maximum daily temperatures near the bottom during late July and early August exceeding the 24 C threshold.

Surface and bottom water temperatures at Alisal Habitat Unit 20 (Figure 3-25) showed a consistent pattern of higher temperatures near the surface, when compared to the bottom throughout the late summer and fall 1995 period of monitoring. Maximum daily water temperatures did not approach the 24 C threshold (Figure 3-25) at the bottom, but did approach or exceed the threshold during July and August, 1995 at the surface monitoring location. In addition, daily temperature variation with less at the bottom recorder throughout the monitoring period (Figure 3-25) when compared to diel variation in surface water temperatures.

Buellton

Water temperatures monitored near Buellton (13.6 miles downstream of Bradbury Dam; Figure 3-9) are shown in Figure 3-27 for monitoring from March, 1996 through early August, 1996. Although highly variable, results of water temperature monitoring at this location show a general seasonal pattern of increasing water temperatures throughout the spring and summer. Water temperature monitoring data was also available near Buellton from May 4 to November 28, 1995. Some of the highest average daily and maximum

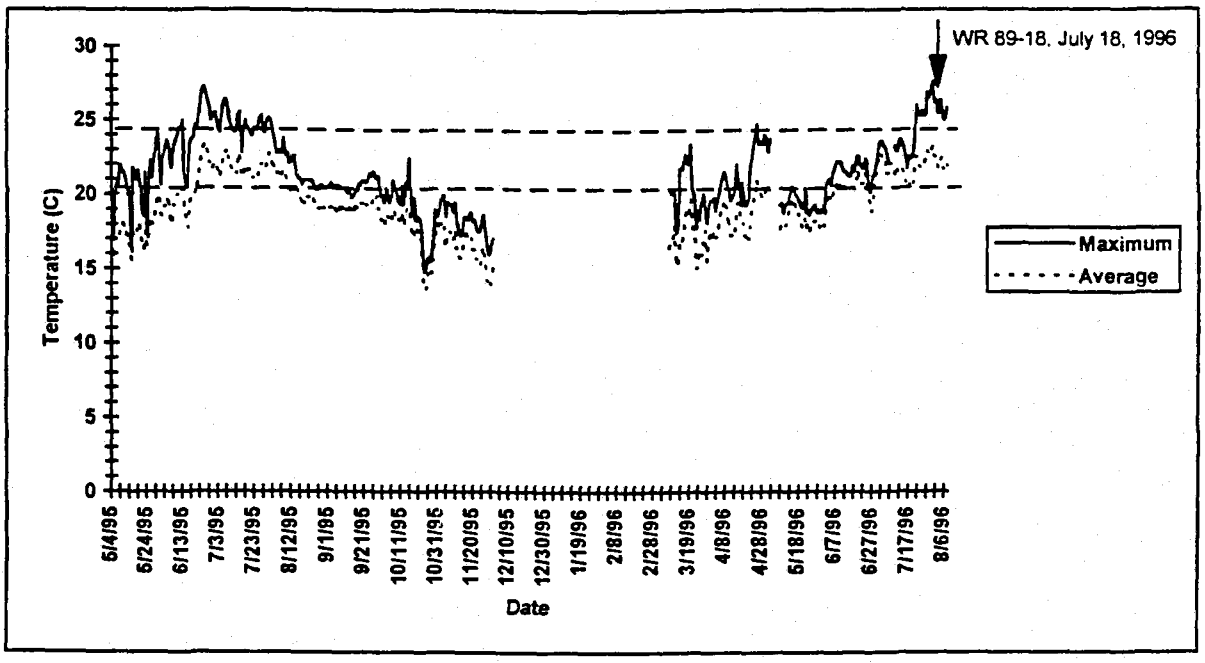


Figure 3-27. **Average daily and maximum water temperatures measured at Buellton (located 13.6 miles downstream of Bradbury Dam).**

water temperatures recorded during the summer occurred at this location. Daily variation in temperature typically ranged from 0-3.5 C between late spring and late summer. Variation between average daily and maximum daily water temperatures decreased during the late summer and fall (late August - November) to 0-1 C.

Weister Ranch

Surface and bottom water temperature monitoring was conducted at Weister Ranch (16.0 miles downstream of Bradbury Dam) during the period from July 30 - September 4, 1996. These data provide information on the relationship between water temperatures before and after WR 89-18 releases. However, the short monitoring period precludes evaluating the analysis of seasonal trends.

Cargasachi Ranch

Water temperature monitoring at the Cargasachi Ranch, located 24 miles downstream of Bradbury Dam (Figure 3-9), from mid-June, 1995 through mid-August, 1996 is shown in Figure 3-28. A pronounced seasonal decline in water temperature was observed between the summer and winter of 1995, coincident with the seasonal decline in air temperature. As a consequence of instrument failure, no water temperature monitoring results are available from January to May, 1996. Water temperature during May and June, 1996 showed a general declining pattern, followed by a pronounced increase in both the average daily and maximum daily water temperature, coincident with the July WR 89-18 controlled release from Bradbury Dam.

Lagoon

Water temperatures within the Santa Ynez River lagoon at Ocean Park (Figure 3-9) are shown in Figure 3-29 for the period from late August, 1995 through mid-August, 1996. Water temperatures within the lagoon showed a general pattern of declining temperatures during the fall and winter, with increasing temperatures during the summer. Water temperatures were generally cooler within the lagoon during the summer months, when compared with locations further upstream within the main Santa Ynez River, which may reflect both the larger volume and water depth of the lagoon, and the influence of the ocean and coastal fog which reduce summer air temperature in the vicinity of the lagoon.

Bottom water temperatures, measured at the upper lagoon (mile 46.5) are shown in Figure 3-30 for monitoring from mid-December, 1995 through early August, 1996. Additional monitoring was performed at the upper lagoon site between August 25 and December 31, 1995, but was not analyzed as part of this report. These data have been summarized in the 1995 Compilation Report. Both maximum daily and average water temperatures were relatively low (less than 20 C) during the winter and early spring. Temperatures increased above 20 C during late April and remained above 20 C, with

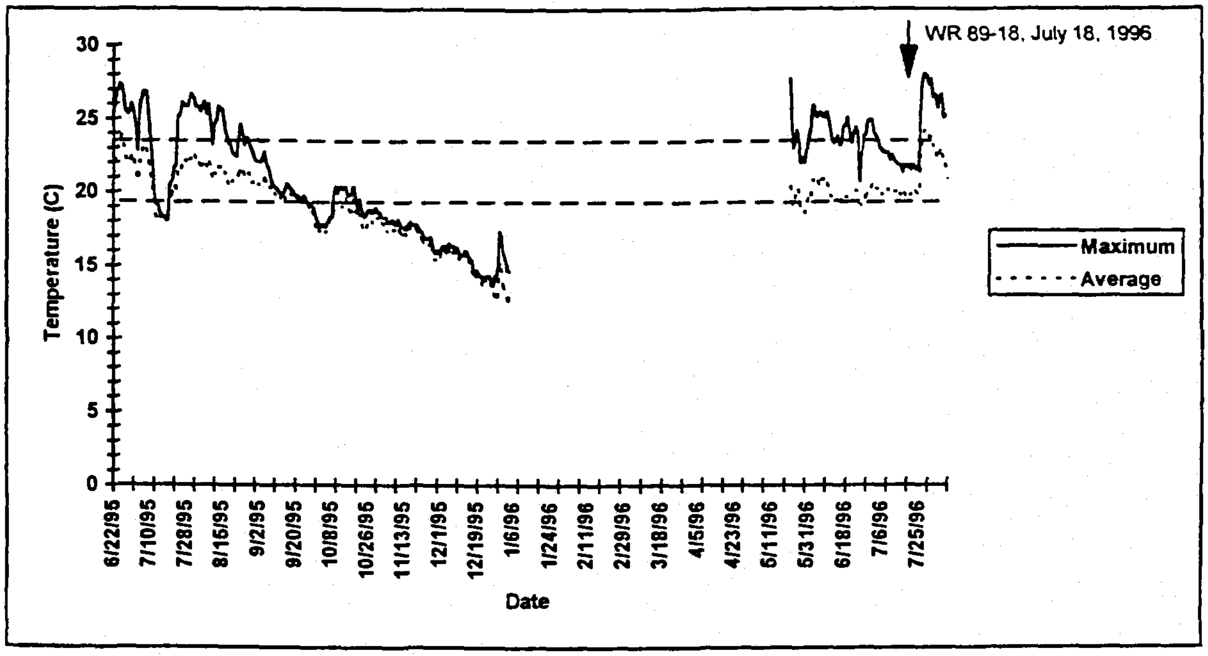
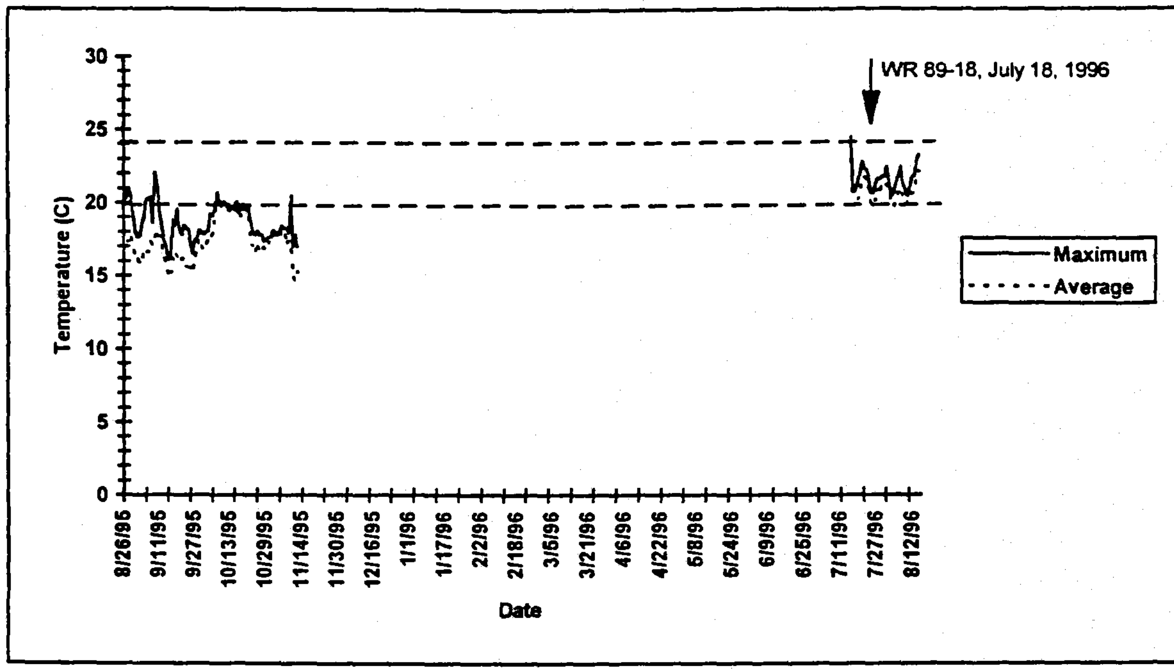


Figure 3-28. Average daily and maximum water temperatures measured at Cargasachi Ranch (located 24.0 miles downstream of Bradbury Dam).



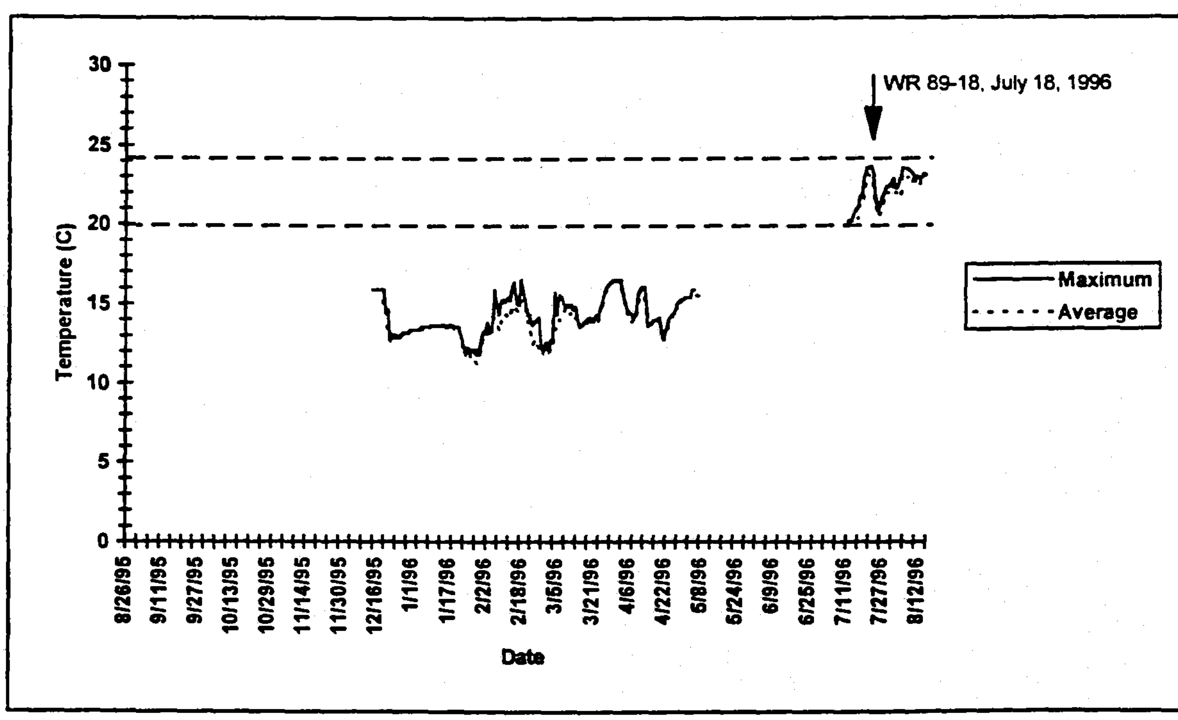


Figure 3-29. **Average daily and maximum surface (Upper Panel) and bottom (Lower Panel) water temperatures measured at Ocean Park within the Santa Ynez River Lagoon (located 47.1 miles downstream of Bradbury Dam).**

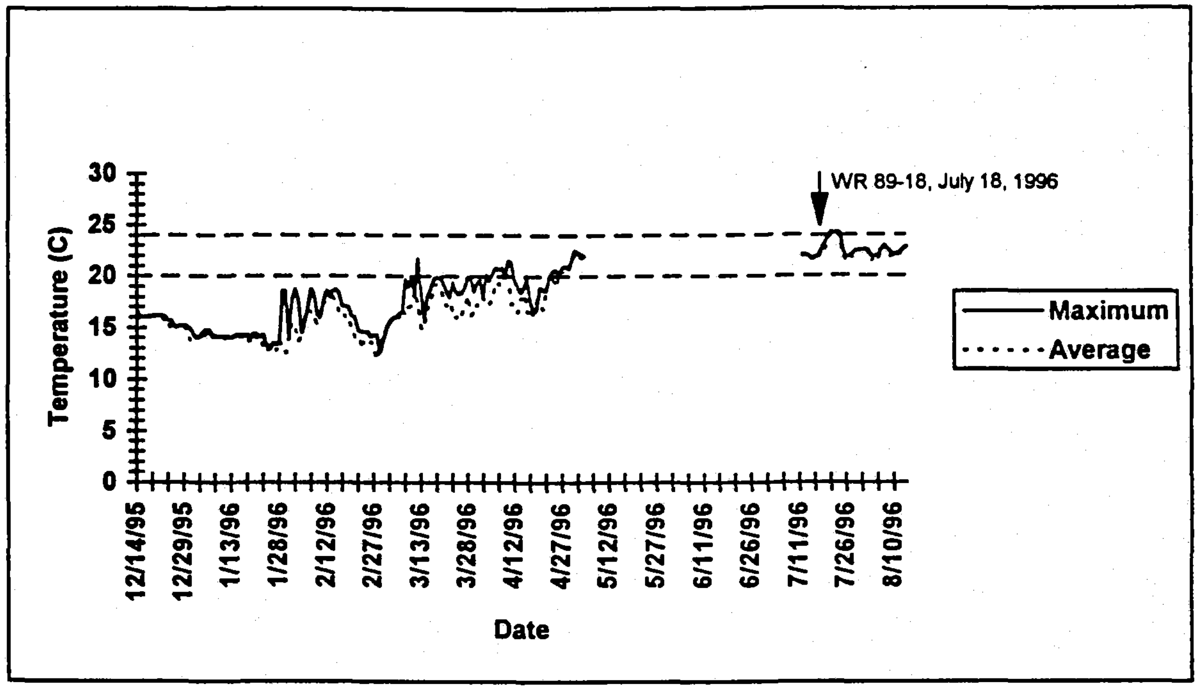


Figure 3-30. **Average daily and maximum bottom water temperatures measured at the Upper Lagoon location within the Santa Ynez River Lagoon (located 46.5 miles downstream of Bradbury Dam).**

maximum temperatures exceeding 24 C during mid- to late-July, 1996 (Figure 3-30). The water temperature recorder was out of service during May and June.

Surface water temperature was monitored within the lagoon immediately downstream of the confluence with the Santa Ynez River (upper lagoon) during the period from approximately mid-March through mid-August, 1996. Average daily and maximum surface water temperatures are shown in Figure 3-31. Water temperatures at the upper lagoon were generally higher than those observed at the mid and lower lagoon monitoring locations, and also exhibited a greater daily variation between the average and maximum temperature. Maximum daily temperatures exceeded the 24 C threshold beginning in early April, with exceedences also observed during late July and early August. The temperature recorder was out of service from late May through early July, precluding detailed analysis of seasonal trends in water temperature conditions at this location.

Analysis of Potentially Stressful Water Temperatures

The potential influence of average daily and maximum daily water temperatures within each of the areas of the mainstem Santa Ynez River on habitat suitability for rainbow trout/steelhead was evaluated where water temperatures have been monitored during 1995-1996. The frequency of average daily water temperatures greater than or equal to 20 C (68 F), and maximum daily water temperatures greater than or equal to 24 C (75 F), was compiled for each location. Maximum daily water temperatures greater than 25 C (77 F) were used to indicate stressful and potentially lethal conditions. As discussed above, the temperature criteria selected for use as a guideline to evaluate potential habitat suitability within the lower Santa Ynez River for steelhead/rainbow trout is not based on detailed nor definitive data regarding the thermal tolerance of steelhead inhabiting the southern portion of their geographic distribution. The fact that rainbow trout/steelhead have been observed inhabiting and growing in areas of the lower Santa Ynez River and tributaries at temperatures considered in this analysis to be highly stressful and/or potentially lethal highlights a need to develop an improved basis for evaluating the biological significance of water temperature conditions on habitat suitability as part of these investigations. Results of this temperature analysis should, therefore, be used as only a general index and guideline of habitat suitability of various locations within the mainstem Santa Ynez River for rainbow trout/steelhead. Variation in the effects of acclimation temperature and thermal tolerance of rainbow trout/steelhead which inhabit the Santa Ynez River, when compared with more northerly stocks, compound the selection of specific temperature criteria for use in this analysis. In addition, the effects of localized cold water upwelling and refugia that occur within the Santa Ynez River, and incomplete temperature records for many of the monitoring locations of interest, prohibit a more comprehensive and rigorous analysis of the effects of water temperature on habitat suitability. Furthermore, as will be discussed later in this section, releases from Bradbury Dam and the resulting instream flows, may also affect average daily and maximum daily water temperatures at downstream locations.

Analyses of 1995-1996 water temperature monitoring results are consistent in demonstrating that water temperatures would be suitable for rainbow trout/steelhead at all locations where monitoring occurred during the late fall, winter, and early spring.

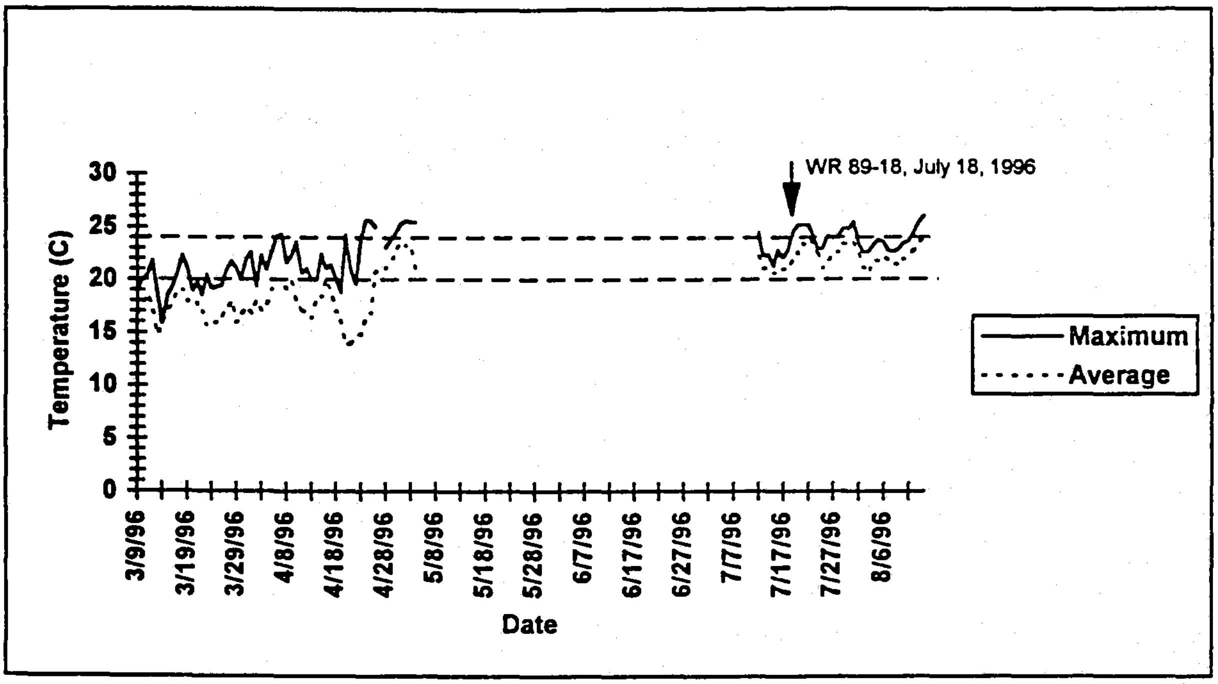


Figure 3-31. Average daily and maximum surface water temperatures measured at the upper lagoon adjacent to the confluence with the Santa Ynez River.

However, during summer (typically June - August) potentially adverse water temperatures (those exceeding either the average daily or daily maximum temperature criteria used in these analyses) were observed in surface thermographs at all mainstem Santa Ynez River monitoring locations. The maximum daily temperature criteria (24 C) was not exceeded in the bottom thermographs (except at Alisal Habitat Unit 48) during the 1995-1996 surveys. In addition, the frequency and magnitude of potentially adverse water temperature conditions increased as a function of distance downstream from Bradbury Dam, with the exception of temperature conditions within the lagoon. Table 3-5 summarizes results of the frequency analysis of seasonal water temperatures exceeding criteria related to conditions which are potentially stressful to rainbow trout/steelhead. Results are briefly discussed below for various mainstem monitoring locations.

Spill Basin and Long Pool

Within the Spill Basin, average daily surface temperature conditions equal to or greater than 20 C occurred during the summer of 1996 (Table 3-5). Monitoring within the spill basin during 1996 showed that average daily water temperatures exceeded the criterion on 14 days in June, and 15 days in July. The maximum daily temperature exceeded the 24 C criterion during 1 day in June, 1996. Temperatures recorded from March to early August, 1996 exceeded the incipient lethal temperature (25 C) on 1 day (26.3 C) in June.

Surface water temperatures within the Long Pool exceeded the average daily criterion in July (11 days), and August (10 days) in 1995, and during April (4 days), and July (18 days) in 1996, however temperature records are incomplete for a portion of the summer 1996 monitoring period. Maximum daily surface temperature did not exceed the 24 C criterion between June and December, 1995 (Table 3-5). Maximum daily water temperature exceeded the 24 C criterion during 17 days in July, 1996. From mid-June, 1995 to mid-August, 1996 surface temperature in the Long Pool exceeded the incipient lethal temperature (25 C) on one day in July, 1996.

The frequency of exceedence was lower within the Long Pool at the bottom monitoring location, during 1995. No temperatures were recorded that exceeded the 20 C criterion from June, 1995 through August, 1996. No observations of bottom temperatures within the Long Pool exceeding the daily maximum criterion of 24 C were observed from the available 1995-1996 temperature monitoring records, however monitoring was interrupted during the spring and early summer of 1996. No temperatures from mid-June, 1995 to mid-August, 1996 exceeded the incipient lethal temperature (25 C).

Refugio Reach

Temperature monitoring results for the Refugio Habitat Unit X (3.4 miles downstream of Bradbury Dam) showed that average daily surface water temperatures were equal to or greater than 20 C between June and November, 1995, with the greatest occurrence during July (26 days), August (29 days), and September (25 days). The frequency of maximum daily water temperatures greater than or equal to 24 C followed a similar pattern, with the greatest frequency of occurrence during July (11 days), August (13 days), and September

Table 3-5. **Results of a frequency analysis of water temperatures measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead.**

Location	Month	Number Days Monitored	Frequency (Days) Average Daily >20 C[1]	Maximum Daily >24 C[1]	Maximum Daily >25 C[1]	Maximum Daily (C)
Spill Basin (0.0 miles)						
Surface	*1996*					
	March	24	0	0	0	16.5
	April	30	0	0	0	18.4
	May	31	0	0	0	19.9
	June	30	14	1	1	26.3
	July	31	15	0	0	21.3
	August	10	0	0	0	16.5
Long Pool (0.5 miles)						
Surface	*1995*					
	June	15	0	0	0	17.3
	July	31	11	0	0	22.3
	August	31	10	0	0	21.6
	September	30	0	0	0	20.8
	October	31	0	0	0	18.5
	November	30	0	0	0	17.4
	December	31	0	0	0	15.3
	1996					
	January	19	0	0	0	14.2
	February	29	0	0	0	17.4
	March	31	0	0	0	19.8
	April	28	4	0	0	22.5
	May	-	-	-	-	-
	June	-	-	-	-	-
	July	31	18	17	1	25.1
	August	15	0	0	0	17.8
Long Pool (0.5 miles)						
Bottom	*1995*					
	June	15	0	0	0	17.0
	July	31	0	0	0	20.3
	August	31	0	0	0	20.4
	September	30	0	0	0	19.5
	October	31	0	0	0	17.8
	November	30	0	0	0	16.7
	December	31	0	0	0	15.0

[1] Average daily temperature equal to or greater than 20 C; maximum daily temperature equal to or greater than 24 or 25 C.

Table 3-5. **Results of a frequency analysis of water temperatures measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead (continued).**

Location	Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Long Pool (0.5 miles) Bottom						
	1996					
	January	4	0	0	0	17.0
	February					
	March					
	April					
	May					
	June					
	July	31	0	0	0	19.6
	August	14	0	0	0	17.1
Refugio X (3.4 miles) Surface						
	1995					
	June	16	4	0	0	23.9
	July	31	26	11	6	26.4
	August	31	29	13	9	26.5
	September	30	25	9	1	25.0
	October	31	1	1	0	24.1
	November	19	5	0	0	23.4
Refugio X (3.4 miles) Bottom						
	1995					
	December	10	0	0	0	18.1
	1996					
	January	31	0	0	0	18.1
	February	29	0	0	0	22.0
	March	31	0	5	2	26.1
	April	30	2	4	1	25.1
	May	3	3	0	0	23.2
Refugio Unit 17 (6.0 miles) Surface						
	1996					
	May	8	1	0	0	23.1
	June	30	8	0	0	23.5
	July	9	2	0	0	21.9
Refugio Unit 17 (6.0 miles) Bottom	*1996*					
	May	9	0	0	0	19.2
	June	30	0	0	0	19.7
	July	9	0	0	0	20.2

Table 3-5. **Results of a frequency analysis of water temperatures measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead (continued).**

			Frequency (Days)			
Location	Month	Number Days Monitored	Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Alisal Unit 48 (7.8 miles) Surface	*1995*					
	May	28	0	0	0	22.9
	June	30	12	9	3	25.5
	July	31	31	27	8	25.7
	August	31	31	26	3	25.2
	September	30	28	1	0	24.0
	October	31	0	0	0	22.6
	November	30	0	0	0	20.8
	December	12	0	0	0	18.7
Alisal Unit 48 (7.8 miles) Bottom	*1995*					
	May	28	0	0	0	23.2
	June	30	12	8	3	25.7
	July	31	31	8	2	25.2
	August	31	31	10	0	23.8
	September	30	24	0	0	21.5
	October	31	0	0	0	21.3
	November	14	0	0	0	20.2
Alisal Unit 45 (7.9 miles) Surface	*1996*					
	May	29	0	0	0	20.4
	June	30	0	0	0	17.9
	July	9	0	0	0	18.7
Alisal Unit 45 (7.9 miles) Bottom	*1995*					
	December	11	0	0	0	18.0
	1996					
	January	31	0	0	0	17.9
	February	29	0	0	0	18.3
	March	31	0	0	0	20.3
	April	30	0	0	0	22.6
	May	31	0	0	0	20.3
	June	30	0	0	0	17.5
	July	31	6	2	0	24.7
	August	7	5	0	0	23.5

Table 3-5. **Results of a frequency analysis of water temperatures measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead (continued).**

Location	Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Alisal Unit 20 (8.7 miles) Surface	*1995*					
	July	7	7	0	0	23.8
	August	31	31	6	1	25.4
	September	30	26	0	0	22.7
	October	31	0	0	0	20.5
Alisal Unit 20 (8.7 miles) Bottom	*1995*					
	July	7	1	0	0	20.3
	August	31	17	0	0	21.3
	September	30	0	0	0	20.0
	October	31	0	0	0	19.7
Alisal Unit 9 (9.5 miles) Surface	*1995*					
	July	7	7	7	7	26.4
	August	31	31	15	7	26.3
	September	30	9	0	0	22.8
	October	31	5	0	0	22.0
	November	30	0	0	0	21.8
	December	12	0	0	0	19.5
	1996					
	January	-	-	-	-	-
	February	-	-	-	-	-
	March	-	-	-	-	-
	April	-	-	-	-	-
	May	28	7	7	2	25.6
	June	30	28	21	17	28.0
	July	31	31	31	30	28.2
	August	8	8	8	7	26.5

Table 3-5. **Results of a frequency analysis of water temperatures measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead (continued).**

			Frequency (Days)			
Location	Month	Number Days Monitored	Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Alisal Unit 9 (9.5 miles)						
Bottom	*1995*					
	July	8	7	0	0	23.8
	August	31	8	0	0	22.0
	September	30	0	0	0	19.0
	October	31	0	0	0	20.8
	November	10	0	0	0	21.5
	December	13	0	0	0	18.5
	1996					
	January	31	0	0	0	18.3
	February	29	0	0	0	21.1
	March	31	0	1	0	24.8
	April	30	0	10	2	25.5
	May	31	0	0	0	21.4
	June	30	0	0	0	20.4
	July	31	31	11	10	27.1
	August	8	8	8	7	26.0
Buellton (13.6 miles)						
Bottom	*1995*					
	May	28	0	1	0	24.1
	June	30	16	16	10	27.3
	July	31	31	30	14	26.4
	August	31	16	2	1	25.0
	September	30	0	0	0	21.6
	October	31	0	0	0	22.4
	November	30	0	0	0	20.0
	December	1	0	0	0	17.1
	1996					
	January	-	-	-	-	-
	February	-	-	-	-	-
	March	24	0	0	0	23.4
	April	30	5	2	0	24.8
	May	27	0	0	0	20.6
	June	30	23	0	0	22.6
	July	30	30	10	10	27.6
Weister Ranch (16.0 miles)	*1996*					
Surface	July	2	2	2	2	26.5
	August	31	31	31	24	27.3
	September	4	4	3	2	26.1

Table 3-5. **Results of a frequency analysis of water temperatures measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead (continued).**

Location	Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Weister Ranch (16.0 miles) Bottom	*1996*					
	July	2	2	2	2	26.4
	August	31	31	31	21	27.1
	September	4	4	4	3	25.9
Cargasachi Ranch (24.0 miles) Surface	*1995*					
	June	9	9	9	9	27.4
	July	31	21	17	15	26.9
	August	31	31	16	11	26.3
	September	30	9	0	0	22.7
	October	31	0	0	0	20.4
	November	30	0	0	0	18.6
	December	31	0	0	0	17.3
Cargasachi Ranch (24.0 miles) Surface	*1996*					
	January	4	0	0	0	15.9
	February	-	-	-	-	-
	March	-	-	-	-	-
	April	-	-	-	-	-
	May	10	2	1	0	24.2
	June	30	10	18	9	25.9
	July	31	18	8	6	28.1
	August	7	7	7	7	26.6
Lompoc (35th Avenue Bridge) Surface	*1996*					
	March	22	0	0	0	22.3
	April	29	6	7	3	25.7
	May	4	4	4	4	25.7
	June	-	-	-	-	-
	July	20	20	12	4	25.6
	August	14	14	3	2	26.1
Lompoc (35th Avenue Bridge) Bottom	*1996*					
	July	20	20	4	0	24.4
	August	14	14	0	0	23.0

Table 3-5. Results of a frequency analysis of water temperatures measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead (continued).

Location	Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Ocean Park (47.1 miles) Surface	*1995*					
	August	6	0	0	0	20.9
	September	30	0	0	0	22.1
	October	31	0	0	0	20.7
	November	12	0	0	0	20.6
	1996					
	July	17	15	1	0	24.5
	August	14	12	0	0	23.3
Ocean Park (47.1 miles) Bottom	*1995*					
	December	18	0	0	0	15.9
	1996					
	January	31	0	0	0	13.7
	February	29	0	0	0	16.4
	March	31	0	0	0	16.5
	April	30	0	0	0	16.5
	May	5	0	0	0	15.9
	June					
	July	20	20	0	0	23.7
	August	14	14	0	0	23.6
Hilton Creek - Upstream of Confluence	*1995*					
	April	6	0	0	0	18.3
	May	31	0	0	0	20.9
	June	30	0	0	0	23.1
	July	30	13	3	3	26.3
	August	19	17	7	3	25.8
Hilton Creek - Shute Pool	*1995*					
	May	29	2	1	0	24.3
	June	30	0	0	0	19.5
	July	31	0	0	0	19.3
	August	21	0	0	0	19.8
Hilton Creek - Spawn Pool	*1996*					
	March	25	0	0	0	23.2
	April	30	0	0	0	15.6
	May	31	0	0	0	15.9
	June	13	0	0	0	24.8

Table 3-5. Results of a frequency analysis of water temperatures measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead (continued).

			Frequency (Days)			
Location	Month	Number Days Monitored	Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Nojoqui Creek - Lower Unit	*1995*					
	April	6	0	6	3	26.0
	May	31	3	23	19	31.5
	June	16	1	13	13	30.5
Nojoqui Creek - Upper Unit	*1995*					
	April	6	0	0	0	23.4
	May	31	1	0	0	23.6
	June	30	8	7	5	25.5
	July	31	27	18	5	25.3
	August	31	12	8	3	25.8
	September	30	0	0	0	22.7
	October	31	0	0	0	20.4
	November	30	0	0	0	17.6
	December	18	10	1	0	24.4
	1996					
	May	29	0	0	0	23.3
	June	28	1	5	5	30.2
	July	20	0	0	0	18.8
	August	8	0	0	0	18.7
Salsipuedes Creek - Upstream of El Jaro Creek	*1995*					
	April	6	0	0	0	20.9
	May	31	0	0	0	21.4
	June	30	0	0	0	23.2
	July	31	0	0	0	23.1
	August	31	0	0	0	23.1
	September	30	0	0	0	20.7
	October	31	0	0	0	18.6
	November	30	0	0	0	16.1
	December	10	0	0	0	15.0
	1996					
	May	28	0	0	0	20.7
	June	25	0	0	0	21.2

Table 3-5. Results of a frequency analysis of water temperatures measured in the Santa Ynez River and tributaries in relationship to various temperature criteria related to habitat suitability for rainbow trout/steelhead (continued).

Location	Month	Number Days Monitored	Frequency (Days) Average Daily >20 C	Maximum Daily >24 C	Maximum Daily >25 C	Maximum Daily (C)
Salsipuedes Creek - Downstream of El Jaro Creek	*1995*					
	April	6	0	0	0	23.6
	May	31	0	2	0	24.8
	June	30	8	15	7	27.4
	July	31	29	25	11	26.0
	August	31	30	26	14	26.2
	September	30	1	7	0	24.9
	October	31	0	0	0	23.7
	November	30	0	0	0	19.1
	December	10	0	0	0	16.7
	1996					
	May	24	6	8	2	26.3
	June	30	14	16	10	27.0
	July	31	31	30	26	27.6
	August	7	7	7	4	25.5
El Jaro Creek	*1995*					
	April	6	0	0	0	22.9
	May	31	0	2	0	24.4
	June	30	10	11	5	22.0
	July	31	30	25	16	26.5
	August	31	29	24	9	26.3
	September	30	0	0	0	23.7
	October	31	0	0	0	20.9
	November	30	0	0	0	17.0
	December	10	0	0	0	14.8
	1996					
	May	23	7	10	4	26.5
	June	30	9	10	8	26.9
	July	31	2	0	0	23.7
	August	7	0	0	0	20.1

(9 days), with exceedences of the criterion on 1 day during October, 1995. Surface water temperatures exceeded the incipient lethal temperature (25 C) during July (6 days), August (9 days), and September (1 day) in 1995. The maximum temperature observed was 26.5 C in August, 1995. No corresponding surface temperature monitoring was performed at this location in 1996. Water temperatures recorded at the bottom location at the Refugio Habitat Unit X during 1996 showed that the average daily temperature criterion was exceeded during April (2 days), and May (3 days), however no data were available later during the summer prior to the 1996 WR 89-18 release, since the monitoring location was dewatered. The maximum daily temperature exceeded 24 C on five days in March and 4 days in April, and exceeded 25 C on 2 days in March and 1 day in April. The 24 C maximum daily criterion was not exceeded in May.

Water temperature monitoring was performed at Refugio Unit 17 during the period from May through July, 1996. Maximum daily surface water temperatures did not exceed 24 C during this monitoring period. Average daily temperatures did not exceed 20 C during the May-July, 1996 period. Rainbow trout/steelhead were observed inhabiting the Refugio reach during the summer of 1996.

Alisal Reach

Average daily water temperatures exceeded the 20 C criterion at the Alisal Habitat Unit 48, located 7.8 miles downstream of Bradbury Dam, during the summer of 1995. The temperature criterion was exceeded on all days during July and August, 28 days in September, with a lower frequency of occurrence during June (12 days). The maximum daily temperature criterion was exceeded on 27 days during July, and 26 days during August, 1995, with a lower frequency of occurrence during June (9 days) and September (1 day). A similar pattern of occurrence was observed in bottom temperatures at the Alisal monitoring location in 1995, with the average daily temperature criterion being exceeded during July (31 days), August (31 days), and September (24 days), with a lower frequency of occurrence during June (12 days). Maximum daily temperatures exceeded the 24 C criterion on 8 days in June, 8 days in July, and 10 days in August. Temperatures exceeding the incipient lethal threshold (25 C) were recorded at the surface in June (3 days), July (8 days), and August (3 days), 1995. At bottom monitoring locations in 1995, temperatures were recorded in June (3 days), and July (2 days) which exceeded the incipient lethal threshold temperature (25 C). The highest observed temperature at the surface was 25.7 C (July), while at the bottom the highest observed temperature was 25.7 C during June, 1995. No corresponding temperature monitoring was performed at this location during the summer, 1996.

Results of temperature monitoring in the vicinity of Alisal Road at Habitat Unit 45 (Beaver Pool) showed that the average daily and maximum daily temperature criteria (20 C) was exceeded in July and August, 1996. Bottom water temperatures at Habitat Unit 45 averaged less than 20 C in monitoring from mid-December, 1995 through mid-July, 1996 (Table 3-5). During late July, 1996 average daily water temperature exceeded 20 C on 6 days, with exceedences on 5 out of 7 days monitored in August, 1996. Maximum daily temperature during July exceeded the 24 C threshold on 2 days. Maximum daily water temperature observed was 24.7 C in July, 1996. Temperatures exceeding the incipient lethal threshold (25 C) were not recorded in monitoring at Habitat Unit 45. Water temperature, measured near the bottom of Alisal Habitat Unit 45 during the period prior to the WR 89-18 releases (May 3- July 19), showed no occasions where the average daily water temperatures exceeded the 20 C criteria. The maximum daily temperature criterion (24 C) was not exceeded prior to late July in 1996. After WR 89-18 releases reached the habitat unit, bottom temperatures exceeded the average daily temperature criteria during 6 days in July, and 5 days in August, 1996 (water temperature monitoring data after August 8 has not been downloaded from the recorders). Maximum daily temperature exceeded 24 C on 2 days in July after initiation of the WR 89-18 release (Table 3-5).

Surface water temperatures monitored at Alisal Habitat Unit 20 during the summer 1995, showed that the maximum daily water temperature exceeded the 24 C criterion on only 6 days in July. The incipient lethal threshold (25 C) was exceeded at the surface for one day in August, 1995. The average daily surface temperatures exceeded the 20 C criterion on seven days in July, 31 days in August, and 26 days in September, 1995. The bottom thermograph at this habitat unit did not record temperatures exceeding 24 C, however average daily temperatures exceeded the 20 C criterion on one day in July, and 17 days August.

Surface water temperatures at Alisal Habitat Unit 9 during the summer, 1995, exceeded the maximum daily temperature criterion (24 C) on 7 days in July and 15 days in August (Table 3-5). The average daily surface water temperature exceeded the 20 C temperature criterion on 7 days in July, 31 days in August, 9 days in September and 5 days in October. The incipient lethal threshold was exceeded on 7 days in July and 7 days in August, 1995. Water temperature near the bottom at this habitat unit was substantially lower in 1995, with the maximum daily temperatures not exceeding the 24 C criterion. The average daily bottom water temperatures exceeded the 20 C criterion on 31 days in July and 8 days in August.

Results of water temperature monitoring at Alisal Habitat Unit 9 in 1996 showed that maximum and average daily surface water temperatures exceeded the 20 and 24 C criteria during the summer, 1996. Average daily surface temperatures exceeded 20 C on 7 days in May, 28 days in June, 31 days in July, and 8 out of 8 days in August, 1996. Maximum daily temperatures exceeded the 24 C criterion during May (7 days), June (21 days), July (31 days), and August (8 out of 8 days). Maximum daily water temperatures at the surface in 1996 exceeded 25 C during May (2 days), June (17 days), July (30 days), and 7 out of 8 days in August (Table 3-5). Maximum daily water temperatures were 28.0 C in June, and 28.2 C in July, 1996. Average daily water temperatures measured at the bottom in Habitat Unit 9 during 1996 were substantially lower than those observed at the surface. Average daily water temperatures did not exceed 20 C between January and June, 1996. Average water temperatures exceeded 20 C in July (31 days), and August (8 out of 8 days) in 1996. Maximum daily water temperatures exceeded the 24 C criterion on 11 days in July and 8 out of 8 days in August, 1996. Maximum daily temperatures exceeded 25 C on 10 days in July, and 7 out of 8 days in August. Maximum daily temperature observed was 27.1 C in July, 1996. Both daily average and maximum water temperatures at the bottom of this habitat unit exceeded the criteria only after WR 89-18 releases had reached the habitat unit.

Buellton

Average daily water temperatures at the Avenue of Flags in Buellton, located 13.6 miles downstream of Bradbury Dam, exceeded both the average daily and maximum daily water temperature criteria during the spring and summer of both 1995 (May, June, July, and August), and 1996 (March-July). The maximum exceedence in 1995 at this location occurred during July, when the average daily temperature criterion was exceeded on 31 days, and the maximum daily temperature criterion was exceeded on 30 days. In 1995, the average daily temperature threshold (20 C) was exceeded in June (16 days), July (31 days), and August (16 days). In 1996, average daily temperature criteria was exceeded in April (5 days), June 23 days), and July (30 days; see Table 3-5). During 1996, the maximum daily temperature criterion exceeded up to 10 days in July. Water temperatures exceeded the incipient lethal threshold (25 C) in June (10 days), July (14 days), and August (1 day), 1995, and July (10 days), 1996.

Weister Ranch

Water temperature monitoring at both surface and bottom locations at the Weister Ranch (16 miles downstream of the dam) during the 1996 WR 89-18 controlled release from Bradbury Dam demonstrated that the average daily and maximum daily temperature criteria were exceeded during 31 days in August at both surface and bottom locations. Both surface and bottom water temperatures exceeded the incipient lethal threshold (25 C) in July (2 days), August (24 days), and September (2 days), 1996. The frequency of exceeding the 25 C criteria was lower for the bottom monitoring location (Table 3-5).

Cargasachi Ranch

Both average daily and maximum daily temperature criteria were exceeded at the Cargasachi Ranch (24 miles downstream of Bradbury Dam), during the summer of 1995 and 1996. The greatest monthly frequency of occurrence was observed in August, 1995, when the average daily temperature criterion was exceeded on 31 days, and the maximum daily temperature criterion exceeded on 16 days. Average daily water temperatures in 1995 also exceeded 20 C during 9 of 9 days sampled in June at the bottom monitoring location. Maximum daily temperature exceeded 24 C at the bottom during June (9 days), July (17 days), and August (16 days) in 1995, with no exceedences in September, October, November, or December. Maximum temperature observed at the bottom was 27.4 C in June, 1995. During 1996 average daily temperatures exceeded 20 C during May (2 days out of 10 monitored), June (10 days), July (18 days), and August (7 out of 7 days). Maximum daily temperatures during 1996 exceeded 24 C in May (1 day), June (18 days), July (8 days), and August (7 days; Table 3-5). Maximum daily water temperature was 28.1 C in July, 1996. Water temperature exceeded the incipient lethal threshold (25 C) during June (9 days), July (15 days), and August (11 days) of 1995 and during June (9 days), July (6 days), and August (7 days) of 1996.

Lagoon

Water temperature monitoring at the upper lagoon (46.5 miles downstream of Bradbury Dam) showed that water temperature was higher at both surface and bottom locations when compared with the more downstream location at Ocean Park (Table 3-5). During the period from March-August, 1996 surface temperatures at the upper lagoon location showed a pattern of increasing frequency in exceeding the average daily 20 C threshold during the spring and summer, with the greatest frequency of exceedence occurring during July and August. Maximum daily temperatures observed exceeded 25C during April, May, July, and August (no temperature monitoring at the upper lagoon surface location occurred during June, 1996 - Table 3-5). Bottom temperatures of the upper lagoon location, measured during July and August, 1996 (Table 3-5), consistently exceeded the average daily criterion of 20 C. Maximum daily temperatures observed during July and August, 1996 were 24.4 and 23.0 C, respectively.

Water temperature monitoring within the Santa Ynez River Lagoon at Ocean Park (47.1 miles downstream of Bradbury Dam) showed that the average daily surface temperature did not exceed the criterion during 1995. The maximum daily water temperature exceeded the criterion on only one day during July, 1996. A similar pattern was observed during 1996 in water temperature monitoring at the bottom of the Santa Ynez River Lagoon in which the average daily temperature criterion was exceeded during July and August. The maximum daily water temperature criterion was not exceeded during 1996. No water temperatures were recorded within the lagoon that exceeded the incipient lethal threshold (25 C).

Longitudinal Temperature Gradient

Water temperature data has been collected at various locations along the mainstem Santa Ynez River since 1993 which can be used to investigate the longitudinal gradient in water temperature downstream of Bradbury Dam. In 1993, biweekly longitudinal temperature plots of daily average water temperature were compiled from July 1 through September 1. Flow releases from Bradbury were 10 cfs during July and August. The releases delivered flows that averaged less than 10 cfs in July, less than 3 cfs in August and less than 1 cfs in September at the USGS gauging station in Solvang (Section 2). Data collected between July 1 and August 1 showed rapid warming of water within the first three miles downstream of Bradbury followed by gradual warming until mile 20 where water temperatures began to gradually cool (Figure 3-32). August 15 and September 1 water temperatures also warmed rapidly within the first three miles below Bradbury Dam (Figure 3-33). In August, temperatures continued to warm gradually past mile 40. In September, water temperatures leveled off at 22 C at mile 20 (Figure 3-33). Insufficient information was collected in 1994 to plot a longitudinal water temperature gradient.

The longitudinal gradient in instream flows and water temperatures recorded in 1995 (Figure 3-34) reflects, in part, the effects of high precipitation and storm water runoff with the main river and tributaries (Section 2), and a 5 cfs sustained release from Bradbury beginning July 9, 1995. Flows measured at the release from Bradbury Dam

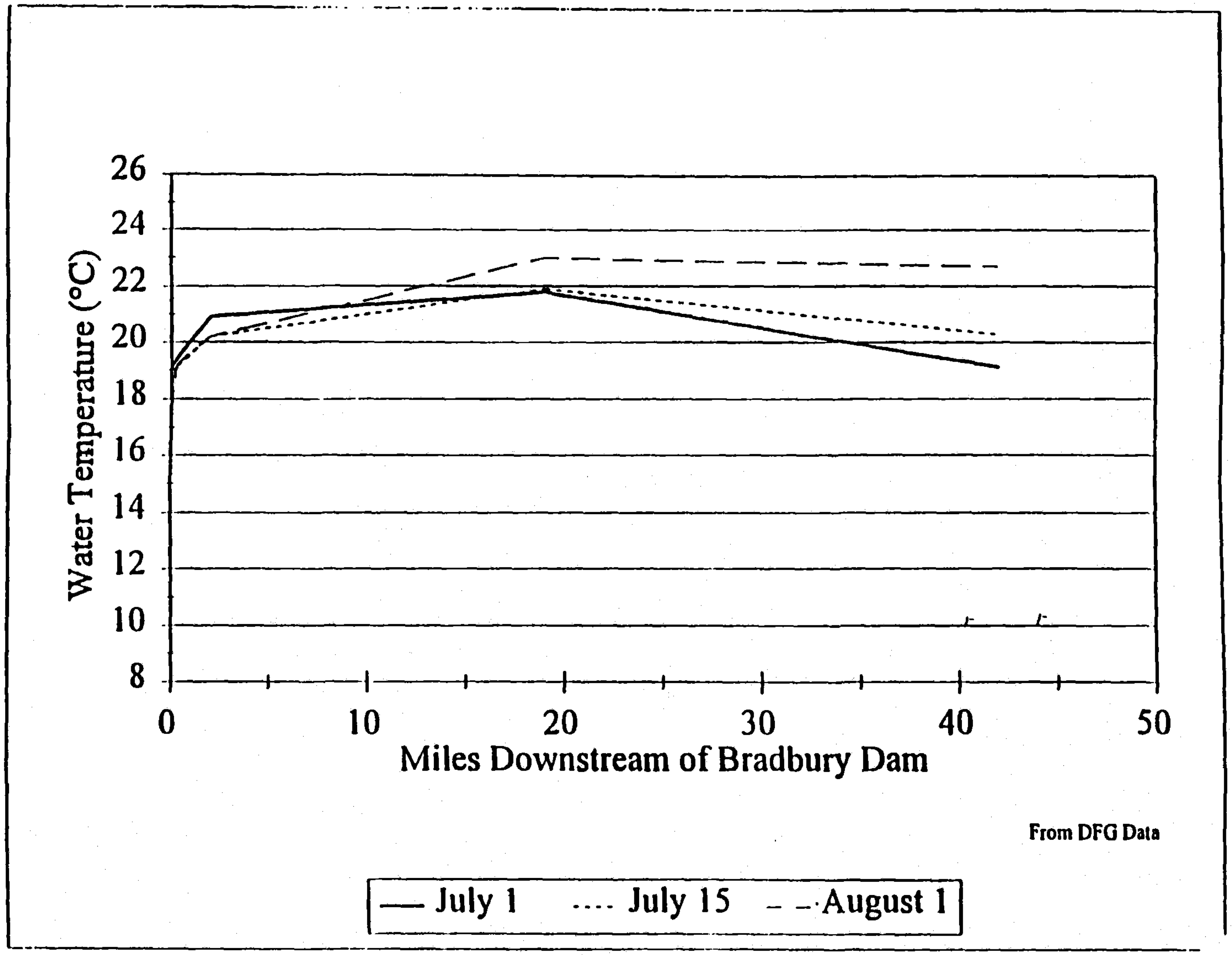


Figure 3-32. **Longitudinal gradient in Santa Ynez River water temperatures (average daily) downstream of Bradbury Dam July 1, July 15, and August 1, 1993. (Source: Entrix, 1995).**

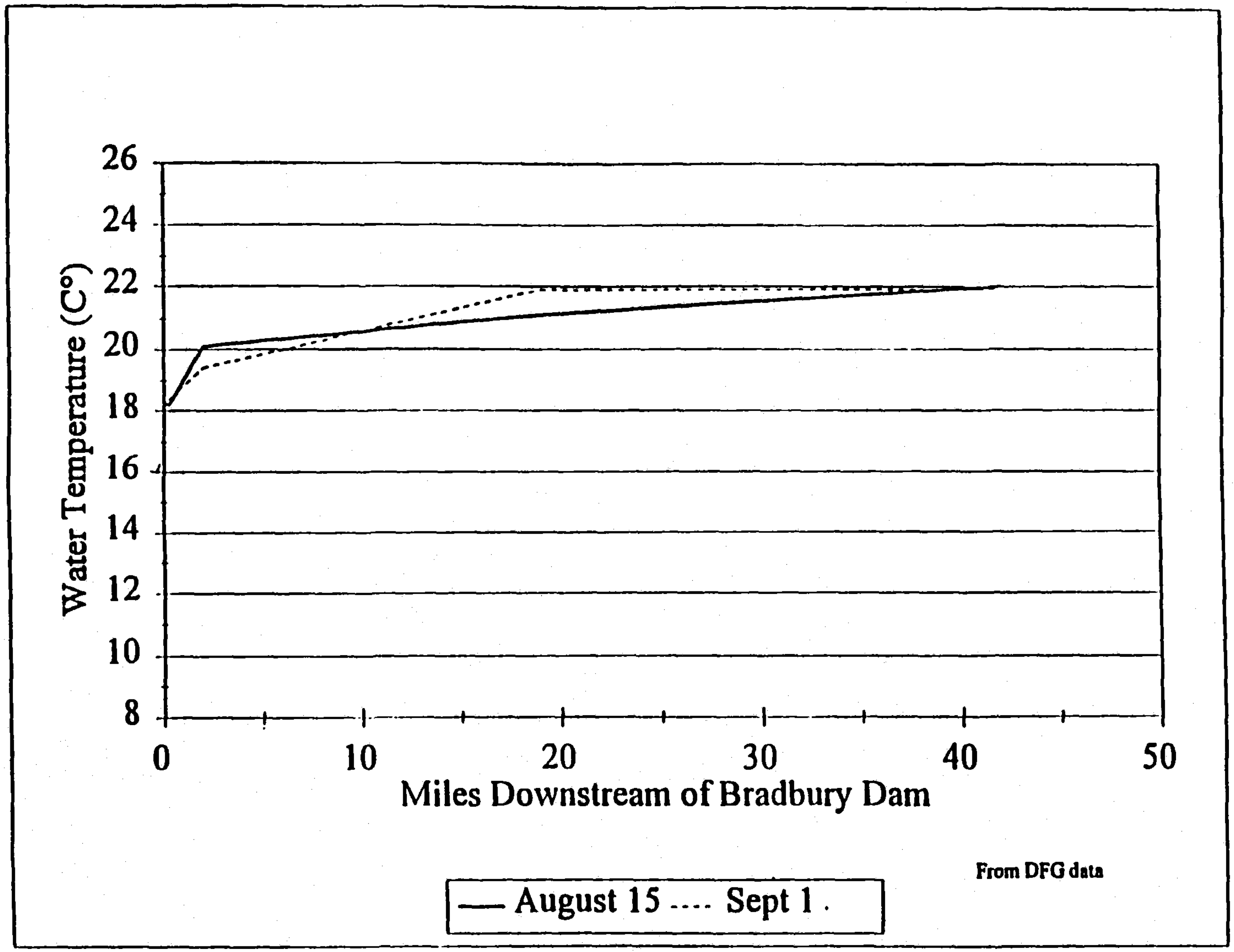


Figure 3-33. **Longitudinal gradient in Santa Ynez River water temperatures(average daily) downstream of Bradbury Dam August 15, and September 1, 1993. (Source: Entrix, 1995).**

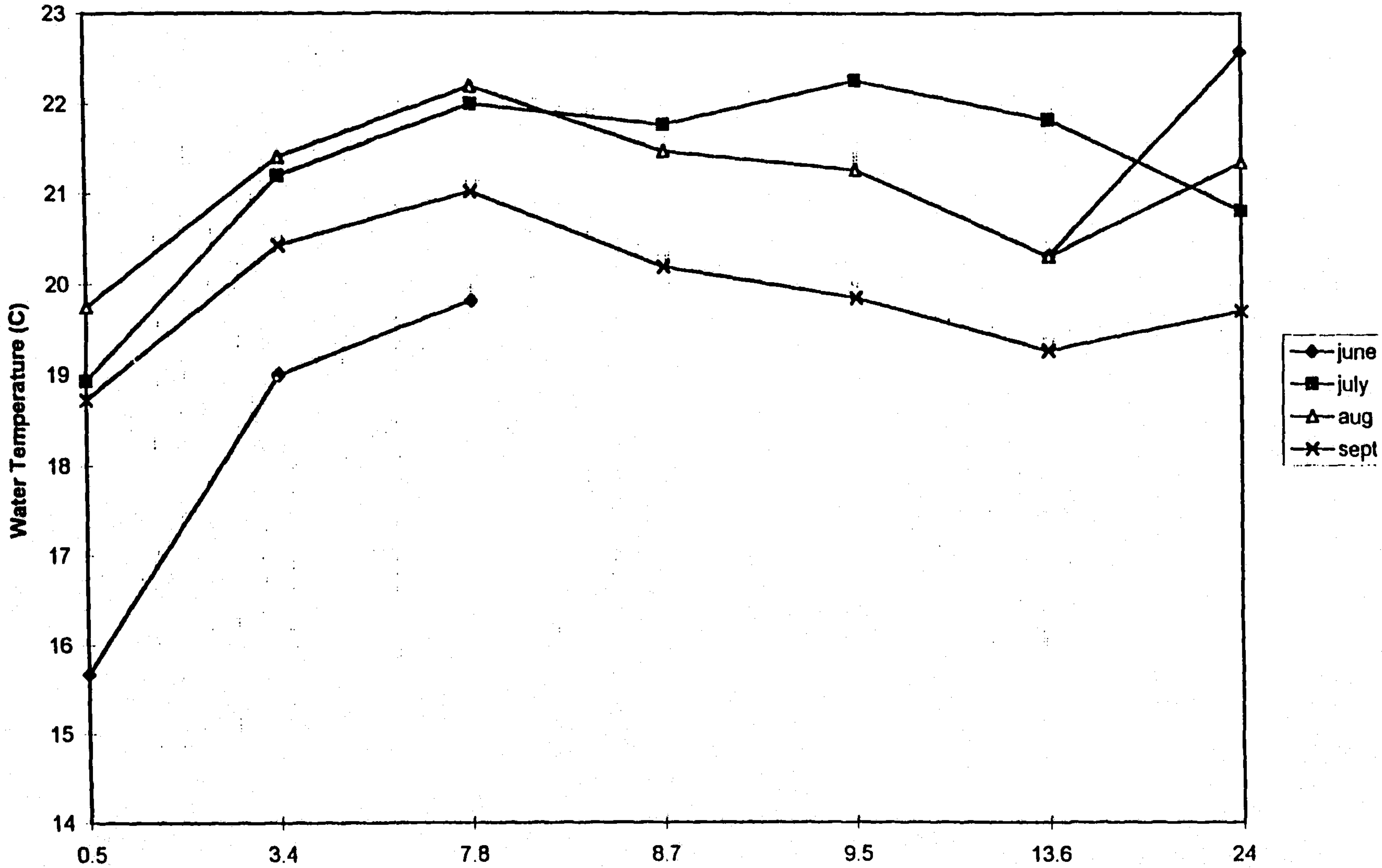


Figure 3-34. **Average monthly water temperatures measured at locations (miles) downstream of Bradbury Dam during June, July, August, and September, 1995. (Source: Engblom, 1995)**

averaged approximately 45 cfs in June and 11 cfs from July 1 - July 8, 1995 (Appendix B). Controlled releases as part of the fish reserve account averaged approximately 3 cfs during mid- to late July and 5 cfs during August and September. Average monthly flow measured at the USGS gauge near Santa Ynez was 43 and 17 cfs in June and July, respectively. Average monthly flow measured at the USGS gauge at Solvang was 82 cfs in June, 21 cfs in July, 0.03 cfs in August, and no measurable flow in September. Additional information regarding daily river flow during the period of these temperature studies is presented in Appendix B. Runoff from the storms persisted well into spring in many of the tributaries which typically go dry. Several areas of mostly run and riffle habitat between Highway 154 bridge and Buellton dried up during the summer months, but flowing water persisted between the dry stretches. River continuity was maintained downstream of Buellton and water continued to flow into the lagoon for the duration of 1995. Longitudinal trends in water temperature observed during the summer (June through September) in 1995 (Figure 3-34) were similar to those in 1993. Summer water temperatures increased rapidly between the dam and mile 3.4, followed by gradual increases in temperature to mile 24 in June. From July through September, water temperatures increased between the dam and mile 3.4, gradual warming to mile 7.8, then cooling from mile 7.8 to mile 24. Water temperatures increased from approximately 19 to 21 C (a 2 C increase) between mile 0.5 and 3.4 during surveys on July 1, 1993. On July 15 and August 1, temperatures increased from approximately 19 to 20.3 C (a 1.3 C increase) between mile 0.5 and 3.4. Temperatures increased approximately 1 C between mile 3.4 and mile 20 on July 1, and approximately 2 C during July. Between mile 3.4 and mile 20 temperature increased approximately 3 C during August 1, 1993. Water temperatures further downstream declined approximately 3 C on July 1, and 2 C on July 15. Water temperatures further downstream remained relatively stable during the August 1 survey. Surveys on August 15 and September 1 (Figure 3-33) again showed a longitudinal gradient in water temperatures. Average daily temperature increased from approximately 18 to 20 C between mile 0.5 and 3.4 on August 15, but then increased only 2 C within the reach extending 40 miles downstream from Bradbury Dam. During the September 1 survey temperatures increased approximately 1.5 C (18 to 19.5) between 0.5 and 3.4 miles downstream of Bradbury Dam, followed by an increase in temperature by mile 20 to 22 C, which remained relatively constant downstream to the confluence with the Santa Ynez River Lagoon at mile 40.

The winter of 1996 was typical of an average rainfall year (Section 2). Tributary runoff was minimal, typically losing continuity with the Santa Ynez River within a week of any particular storm event (Salsipuedes and Nojoqui Creeks being the exception). Water releases from the fish reserve account were 3 cfs from March through mid-July, 1996. Releases from the fish reserve account did not affect the river below mile 3.0. Below river mile 3.0, the river began to dry in May. When WR 89-18 releases were initiated July 18, much of the lower river was dry with the exception of some pool habitats where thermographs were deployed. Thermograph locations were pool habitats, and with the exception of the spill basin, did not have water flowing into them until after July 18. Summer air temperatures in 1993 were among the warmest on record. These cooler water temperatures could represent evidence that upwelling occurs in some pool habitats and is an important factor in reducing water temperatures in habitats that persist during the warm summer months. Additional information regarding the longitudinal temperature gradient during the summer of 1996 is discussed below in the Section, "Temperature Response to River Flow".

A multiple regression analysis was performed using water temperature data collected at the outlet structure from Bradbury Dam, the Long Pool (0.5 miles downstream), Refugio (3.4 miles downstream), Alisal (7.8 miles downstream), Buellton (13.6 miles downstream), and Cargasachi Ranch (24 miles downstream), during the summer and early fall of 1995. Also included in the regression analysis was data on average daily and maximum daily air temperature, measured at Santa Ynez, and instream flow releases from Bradbury Dam as part of the fish reserve account. The regression analysis was performed to predict average daily and maximum daily water temperatures during each month at locations downstream of Bradbury Dam. Using the regression analysis, we were able to (1) identify those environmental factors which were statistically significant ($P < 0.001$) in influencing downstream water temperatures, and (2) use the resulting regression equation to calculate the distance downstream of Bradbury Dam during each month, which satisfied the initial habitat criterion of average daily water temperatures less than 20 C, and maximum daily water temperatures less than 24 C. During the period of these analyses, stream flow, measured at the USGS gauge in Solvang, averaged 82 cfs during June (42-145 cfs), 21 cfs in July (0.3-100 cfs), and 0.03 cfs in August (0-0.4 cfs), with no measurable flow at the USGS gauge during September. Releases from the fish reserve account began July 9, and continued through the end of the October monitoring period used in these analyses, at a flow rate ranging from 4-16 AF per day (2-8 cfs), with a release of 10 AF per day (5 cfs) occurring during the majority of the period.

The regression analysis on average daily water temperature was statistically significant ($P < 0.0001$; $r^2 = 0.67$). Distance downstream of the dam, air temperature, month, outlet temperature from Bradbury Dam, and stream flow were all found to be statistically significant factors in the regression. Using this regression equation, mean daily water temperature less than 20 C was predicted to occur at river mile four during June, mile one during July, mile one during August, mile three during September, with temperatures all less than 20 C within the seven miles downstream of Bradbury Dam included in this analysis for October. The results of this regression analysis are generally consistent with field temperature observations in showing that average daily water temperatures during the summer months less than 20 C, even under relatively high stream flow conditions during June and July, is limited to approximately a 1-3 mile reach below Bradbury Dam.

Results of this temperature analysis indicating that, within the mainstem river, habitat having average daily temperatures less than 20 C throughout the year, is limited to the upper 1-3 miles below Bradbury Dam and have not been reconciled with the observation of rainbow trout/steelhead surviving and growing further downstream in areas where water temperatures, based on the general guidelines used in these analyses, would result in stressful and/or potentially lethal temperature conditions. The discrepancy between the interpretation of the biological significance of various water temperature conditions and habitat suitability within the mainstem Santa Ynez River and tributaries, and the observed geographic distribution and survival of rainbow trout/steelhead within the system need to be reconciled as part of future analyses. Consideration needs to be given to alternative thermal tolerance criteria that may be more suitable in representing habitat conditions for rainbow trout/steelhead within the southern portion of their geographic distribution, and particularly within the lower Santa Ynez River.

A similar statistical analysis was performed using maximum daily water temperature over the same time period and environmental conditions as described above. The regression equation was statistically significant ($P < 0.0001$; $r^2 = 0.6$), with distance downstream, air temperature, month, and outlet temperature all being identified as statistically significant factors in predicting maximum daily water temperature. Stream flow in this regression analysis, however, was not found to be statistically significant ($P = 0.15$) as a factor influencing maximum daily water temperature. Using the regression equation to calculate the suitability of maximum daily water temperatures within the seven mile reach below Bradbury Dam predicted that maximum daily water temperature would be less than 24 C during June, would be less than 24 C in the first three miles downstream of the dam in July, the first four miles downstream during August, and did not exceed the 24 C criterion in either September or October for the seven mile reach included in these analyses.

Some differences exist between results of the regression analysis and the frequency analysis of actual water temperatures at various monitoring locations (both average daily and maximum daily), as a consequence of rounding actual water temperature data before performing the frequency analysis. Results are, however, in general agreement between the predicted temperature distribution, and that observed as part of actual field monitoring in suggesting that elevated water temperatures occur within a relatively short distance downstream of Bradbury Dam, which may result in physiological stress, reduced growth rate, and reduced suitability of habitat conditions as rearing and oversummering habitat for rainbow trout/steelhead. In contrast, temperature conditions observed at various downstream locations that were predicted to contribute to stressful and/or potentially lethal conditions based on the assumed temperature threshold criteria may not result in reduced survival or growth if rainbow trout/steelhead inhabiting the lower Santa Ynez River have substantially greater thermal tolerance than more northerly stocks used as the basis for developing the general temperature guidelines used to evaluate habitat suitability in this report.

A more detailed and comprehensive evaluation of habitat suitability within the lower Santa Ynez River and tributaries, based on water temperature monitoring results, will require greater reconciliation between the actual distribution of fish within the river and temperature guidelines and criteria used to evaluate potential habitat suitability. Additional information regarding the thermal tolerance of rainbow trout/steelhead inhabiting the southern portion of their geographic distribution will be needed to help refine the interpretation and analyses of these and additional monitoring results on the lower Santa Ynez River, and for use in evaluating the biological benefits of alternative management actions on the availability and suitability of habitat within this portion of the watershed.

Results of these statistical analyses for both average daily and maximum daily water temperatures produced predictions which were generally consistent with those derived from the simulation temperature model (Entrix, 1995), and from empirical data. The regression analysis is limited, however, in that it does not take into account a variety of factors which may affect river water temperatures. Instream flows during the period when water temperatures were monitored for use in this analysis declined from an average of 80 cfs in June to no measurable flow during September. The rapidly declining flows, in combination with seasonal patterns of increasing water temperatures during the summer may have biased or obscured the true effect of flow on temperature. In addition, results of field data indicate that flow may change temperature dynamics within deeper water pools including both effects on vertical stratification within the pool and may mask effects of cool groundwater upwelling which were not taken into account as part of this statistical analysis. Furthermore, the statistical analysis did not include consideration of shading by riparian vegetation on water temperatures within the reach of the Santa Ynez River immediately below Bradbury Dam. The dynamic relationship between various environmental factors and Santa Ynez River water temperature may, or may not, follow a consistent pattern (e.g., linear relationship) over the range of environmental conditions represented by changes in air temperature, water temperature, and release temperatures from Bradbury Dam, which all interact during the summer months to influence subsequent downstream water temperature. The influence of these various factors in inter-relationships, which were not explicitly accounted for in the regression analysis, is reflected by the relatively low r^2 values for both average daily water temperature (r^2 = 0.67), and maximum daily water temperature (r^2 = 0.6). Additional data, representing a broader range of environmental conditions, in addition to refinement of the statistical analyses, would be required to increase the overall power and utility of this approach to evaluating water temperature conditions within the Santa Ynez River downstream of Bradbury Dam. Based on the relative consistency of results and predictions among the various approaches used to evaluate Santa Ynez River water temperatures occurring during the summer, and the geographic area downstream of Bradbury Dam which may provide suitable habitat based on temperature conditions, extensive additional effort to further refine these statistical relationships does not appear to be warranted at this time. As noted above, additional effort should be devoted, however, to developing a better understanding of the biological response of rainbow trout/steelhead inhabiting the lower Santa Ynez River to seasonal patterns in water temperature conditions and the associated thermal tolerance of these fish. This new information will be used to improve the guidelines and framework within which future water temperature monitoring results and modeling efforts can be evaluated to assess habitat suitability under current conditions, and in response to potential future management actions.

Diel Fluctuations

In small streams where daily maximum temperatures approach upper incipient lethal thresholds, salmonids can thrive if the temperature is high for only a short period of time and then declines into the optimum range (Bjornn and Reiser 1991). Bjornn and Reiser reported that in an Idaho stream where summer maximum temperatures were 24-26°C, and average daily temperatures were also relatively high, most young salmon and trout moved upstream or into tributaries where temperatures were lower. Hokanson *et al.*, (1977) stated that the maximum temperature at which a rainbow trout population can be expected to maintain its weight for 40 days was a constant temperature of 23°C and a fluctuating mean temperature (+- 3.8°C) of 21°C. The effect of water temperatures on the physiological condition and stress levels for rainbow trout/steelhead and other fish species varies in response to a number of factors. These factors include the availability of food supplies, daily variation in water temperatures, the absolute maximum water temperature and the duration of exposure to various water temperatures within the day, acclimation temperature, and varying thermal tolerances of various lifestages within a species. In addition, there may be geographic variation (e.g., clinal gradients) in the tolerance of a species to various environmental factors including water temperature which may, for example, increase the tolerance of rainbow trout/steelhead within the southern portion of their geographic distribution to elevated water temperatures. Vertical stratification in water temperatures, in addition to microhabitats within various habitat areas, also offer the opportunity for refuges from elevated water temperatures. The biological significance of various water temperature conditions is difficult to interpret. The biological significance of exposure to various temperatures depends, in part, on both the absolute temperature and variation in temperature which occurs within a day. Acclimation to seasonal temperatures, food supply, and behavioral responses of fish may all influence their response to seasonal water temperature conditions. Temperature criteria which are established primarily from laboratory investigations provide general guidelines for evaluating the significance of different temperature conditions that occur as part of field studies. These general temperature criterion guidelines should not be viewed, however, as absolute thresholds for biologically significant temperature effects which may occur under all conditions.

The general temperature criteria, which have been used in this report, include an average daily water temperature of 20 C, a maximum daily water temperature of 24 C, and a potentially incipient lethal temperature of 25 C. These general temperature criteria should be viewed as a guideline for assessing and evaluating the potential quality and suitability of various habitats within the lower Santa Ynez River, but should not be considered as absolute threshold values. As noted above, other temperature criteria (e.g., an average daily water temperature of 21 or 23 C, or other values) could have been used in these analyses of potential habitat suitability. In general, the higher the temperature criterion selected (either average daily or maximum daily temperature), the lower the expected frequency of exceedences, and the further the distance downstream from Bradbury Dam where water temperatures would fall within acceptable limits based on the elevated criterion.

In 1995 diel variation in surface water temperatures in the Santa Ynez River mainstem varied seasonally and between locations. During summer months, 24 hour temperature fluctuations typically ranged between 5-8°C with lower diel variation at stations near the dam. At Alisal Habitat Unit 20 (mile 8.7), diel temperature fluctuations were generally between 2-5°C. At the Long Pool, summer diel fluctuations were between 2-3°C. At miles 7.8 and 9.5, variations were between 5-6°C. The largest and most consistent summer diel variations were recorded at river miles 3.4, 13.6, and 24, which had diel variations between 7-8°C.

When water temperatures began to decrease in September, 24 hour diel variations between 2-4°C were recorded at all thermograph locations except one. At Alisal Habitat Unit 9 (mile 9.5), variations in diel temperature were recorded between 3-6°C.

Bottom thermographs at miles 0.5, 7.8, 8.7, 9.5 recorded much smaller 24 hour diel variations in water temperature during both summer and fall when compared to surface recorders at those locations. Generally, bottom temperatures were 2-3°C cooler than surface temperatures. Thermographs at miles 0.5, 8.7, and 9.5, recorded the smallest variations of 0-3°C over a 24 hour period. The bottom thermograph at mile 7.8 recorded a slightly higher diel variation of 3-7°C during both summer and fall.

Surface and bottom thermographs were deployed in 1996 at miles 0.5, 7.9, 9.5, 16.0, and two locations within the lagoon (Ocean Park and upper lagoon); bottom thermographs were deployed at miles 13.6 and 24.0 prior to WR 89-18 releases. In 1996, 24 hour temperature variations were generally lower before the WR 89-18 releases, when compared to temperature variation after WR 89-18 releases which began July 18, 1996. Daily variation between minimum and maximum recorded temperatures, and various monitoring locations, are shown in Figure 3-35, based on water temperature monitoring results for a period of 14 days before the 1996 WR 89-18 releases, and for a period of 14 days after initiation of the releases. Prior to the release, the average daily temperature variation at the surface within the Long Pool was lower after initiation of the release, when compared with temperature variations before the WR 89-18 releases were begun. The pattern in diel variation observed in 1996 is consistent with the observed temperature variation within the Long Pool before and after controlled releases were initiated in 1994 (Figure 3-36).

Results of hourly water temperature monitoring within the Long Pool before and after initiation of WR 89-18 releases in 1994 and 1996 showed a similar pattern. Water temperatures during 1994 (Figure 3-36) during early to mid July, prior to WR 89-18 releases typically varied from approximately 20 to 24 C, with a diel variation of approximately 3 C. Immediately following the initiation of the WR 89-18 releases, water temperature declined to approximately 13 C, with a corresponding reduction in diel variation to approximately 1 C. A similar pattern was observed in water temperatures within the Long Pool during the summer of 1996 (Figure 3-37). Water temperatures during early to mid July ranged from approximately 21 to 25 C, which declined to 16-17 C following initiation of the WR 89-18 release. Within the Long Pool the initiation of WR 89-18 releases during the summer, during both of these years, resulted in (1) a rapid reduction in absolute water temperatures, and (2) a reduction in diel variation in water temperature after initiating the release.

Water temperature variation within the Long Pool near the bottom was low and relatively consistent, both before and after the 1996 controlled releases. Water temperature data collected throughout the 1993-1996 monitoring period has consistently demonstrated that diel variation in water temperatures at the bottom of the Long Pool is small, and stable, over a range of environmental conditions including variation in releases from Bradbury Dam and seasonal variation in air temperature. The stability of temperatures near the bottom of the Long Pool reflect, in part, the affect of water depth and volume in reducing short-term (daily) temperature fluctuations. In addition, during the late spring and summer months vertical stratification in water temperature occurs within the Long Pool with substantially warmer temperatures near the surface, and colder temperatures near the bottom. During the period of vertical stratification, diel temperature variation near the

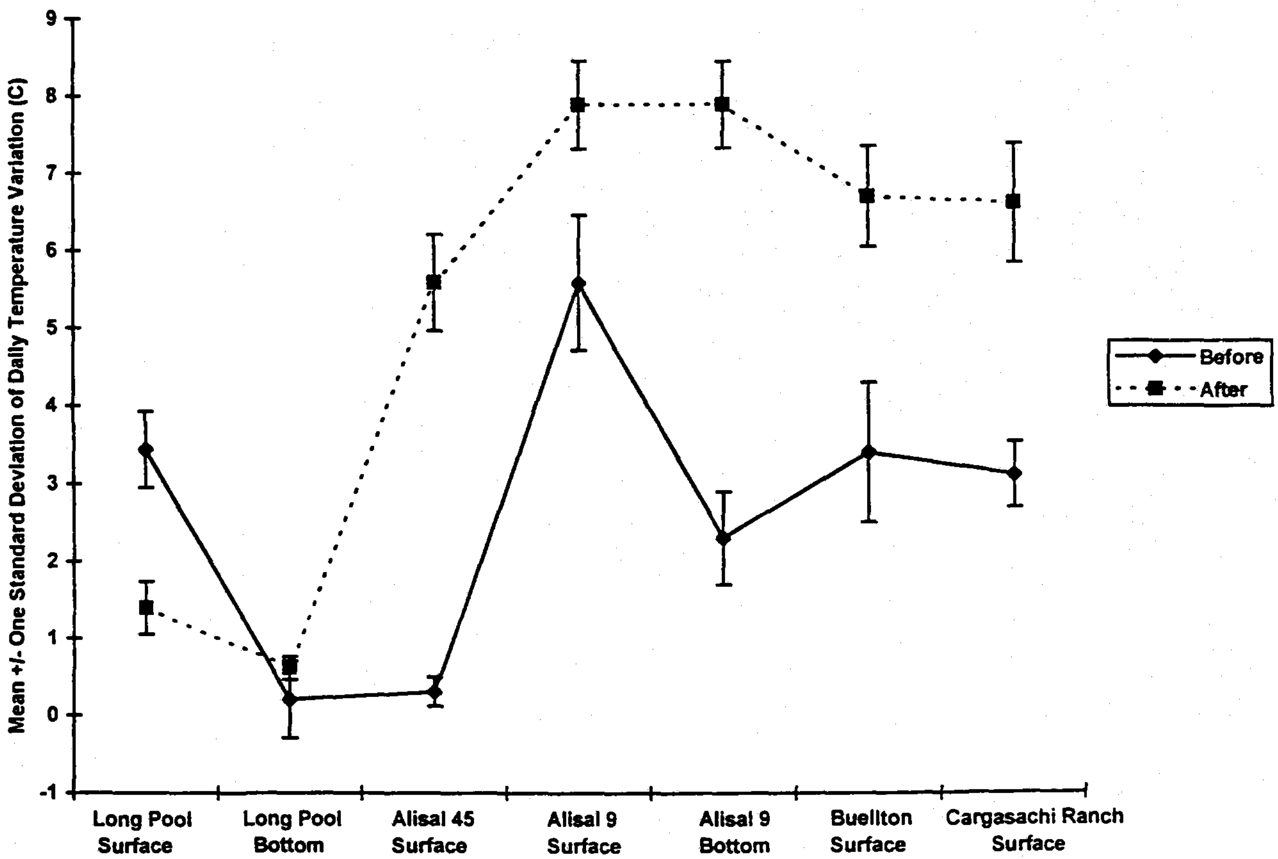


Figure 3-35. **Mean and standard deviation of diel temperature variations at various water temperature monitoring locations recorded before and after 1996 WR 89-18 releases were initiated.**

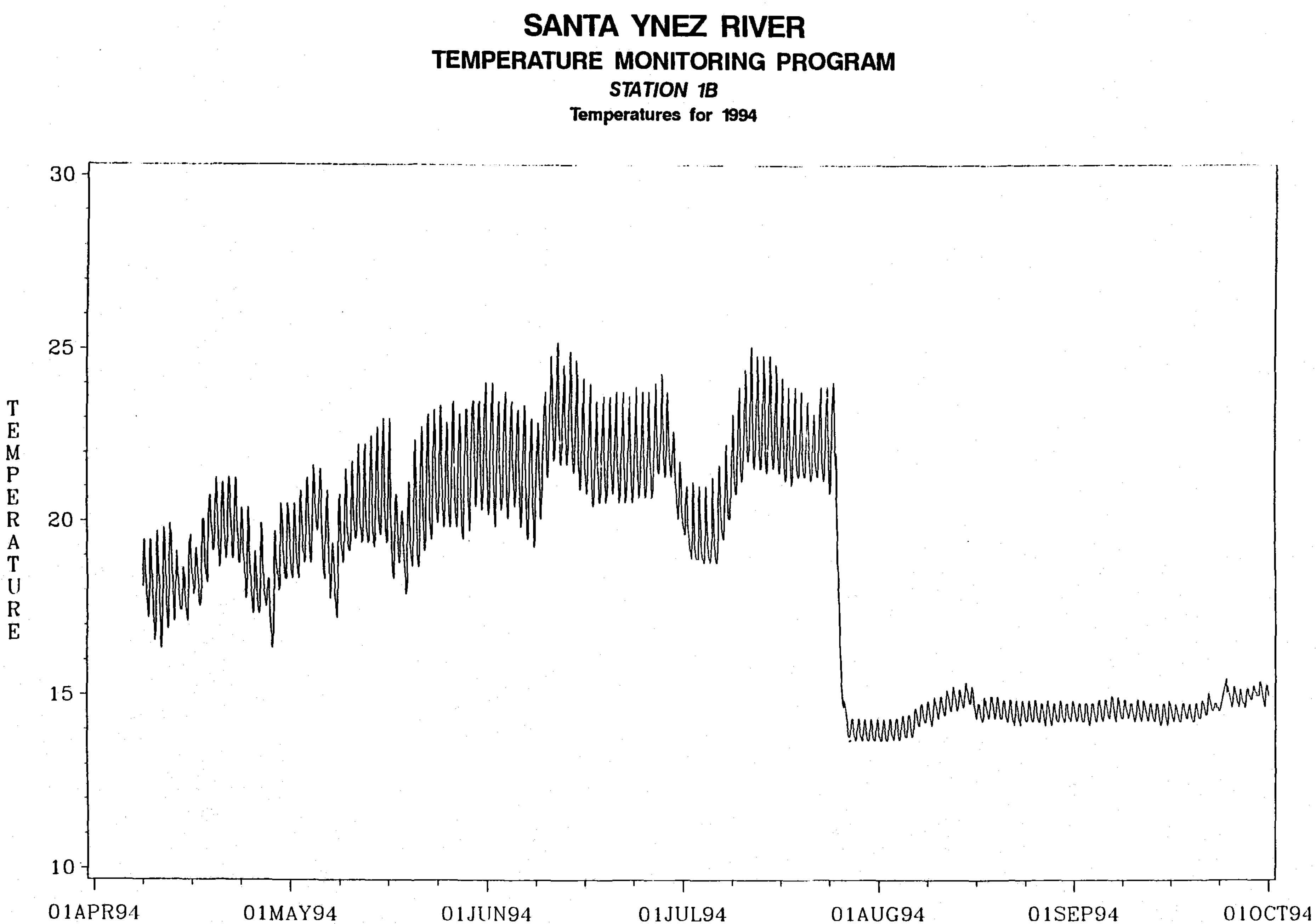


Figure 3-36. **Hourly water temperatures measured near the surface within the Long Pool before and after initiation of the 1994 WR 89-18 releases. (Source: Hanson Environmental, Inc., unpublished data).**

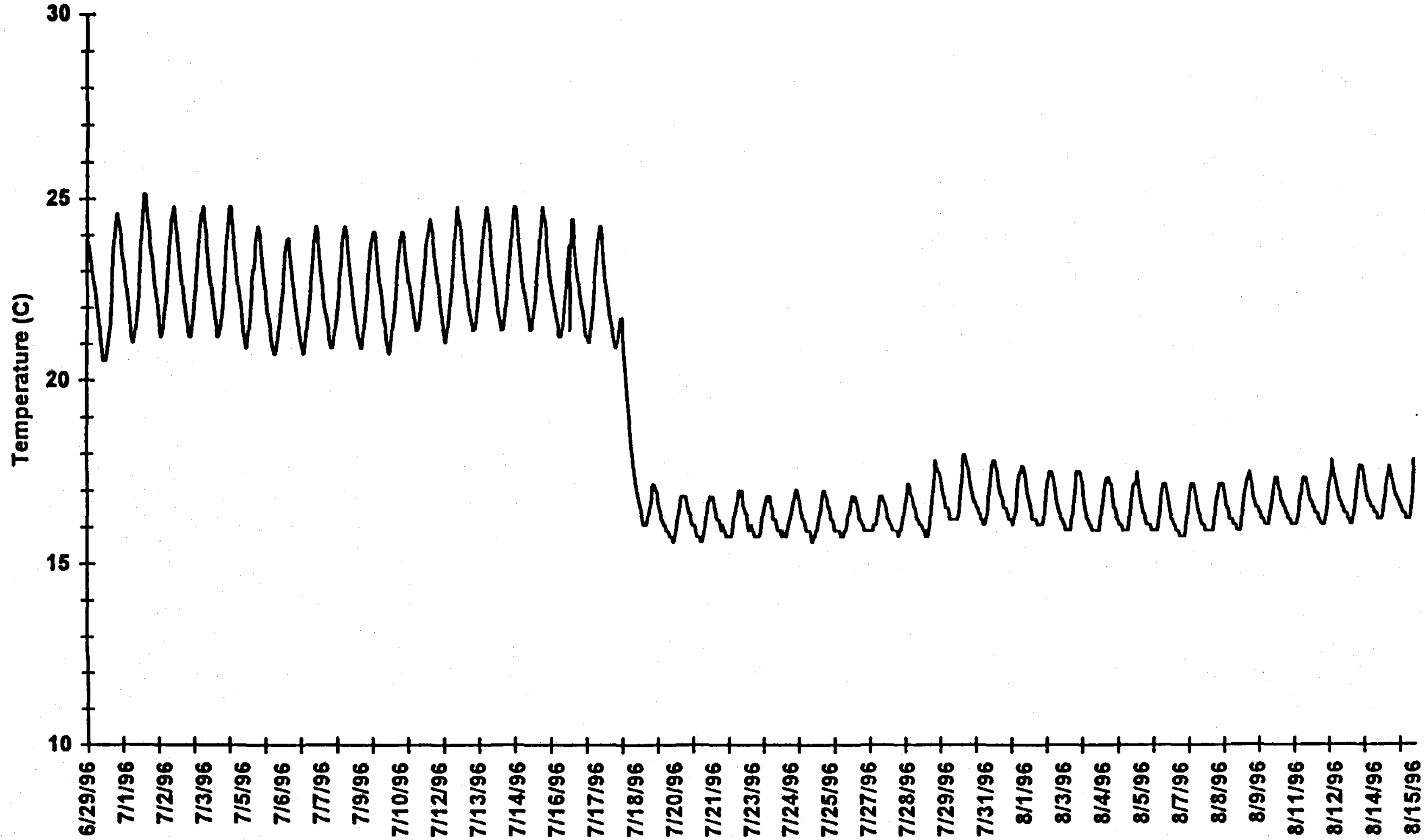


Figure 3-37. **Hourly water temperatures measured near the surface within the Long Pool before and after initiation of the 1996 WR 89-18 releases.**

bottom of the Long Pool is consistently and substantially less than temperature variation observed within the upper part of the water column.

Diel temperature variation is characterized by a longitudinal gradient with greater daily variation in temperature occurring as a function of distance downstream from Bradbury Dam. Diel temperature variation increases substantially between the Long Pool (mile 0.5), and Alisal Habitat Unit 9 (9.5 miles) downstream of the Dam. Diel temperature variation remains relatively high at locations further downstream, including Buellton (mile 13.6), and Cargasachi Ranch (mile 24.0).

The 1996 WR 89-18 releases resulted in a reduction in diel temperature variation within the Long Pool, however, diel temperature variation was consistently higher at all monitoring locations between Alisal Habitat Unit 45 (7.9 miles downstream of Bradbury Dam), and Cargasachi Ranch (24 miles downstream of Bradbury Dam) after initiation of 1996 WR 89-18 releases when compared with diel temperature variation prior to the controlled releases. The observed pattern of increased diel temperature variation at these downstream monitoring locations after the initiation of controlled releases is consistent with the general pattern observed in the longitudinal gradient for absolute temperatures. Results of these analyses are consistent in showing that increased instream flow releases under the current habitat and operating conditions do not result in either a reduction in absolute temperature, or in daily variation in temperature at temperature monitoring stations downstream of the Long Pool. Unfortunately, as a result of denied access to private lands water temperature monitoring before and after the 1996 controlled releases could not be made at intermediate points along the Santa Ynez River, such as monitoring at the Highway 154 Bridge (Figure 3-9), which would provide greater resolution on the geographic distance downstream of Bradbury Dam where increased instream flow releases contribute to reductions in summer water temperatures.

Cold Water Refuges

Temperature data collected in 1995, during both snorkel surveys and from thermograph units, strongly suggests that localized areas of cool water upwelling exist in the mainstem Santa Ynez River that could offer refuge for over summering/rearing rainbow trout/steelhead. During snorkel surveys, divers noted localized areas of cooler water in various habitat units. These cool water areas were usually associated with blue-green algae growing on the substrate. Temperature measurements following the snorkel surveys confirmed that some of these localized areas were between 2-3°C cooler than the surrounding water. The cool water upwelling usually did not influence an area of more than two to three square feet at zero to low flow conditions. Cooler water areas persisted in two revisited pool units in Alisal Reach and four revisited pool units in Refugio Reach. Another small upwelling location was found in Cargasachi Reach near a boulder outcropping area. This particular location was too small to influence the surrounding warm water.

Field measurements confirm that dissolved oxygen concentrations close to the substrate associated with cool water upwelling areas or areas with subsurface flows are low (1-2 mg/l; E. Ballard, pers. comm.). Dissolved oxygen concentrations increased with distance from the substrate. Similar observations were made as part of water quality measurements within pool habitats during the summers of 1995 and 1996. Cooler water temperatures and lower dissolved oxygen concentrations have also been measured at the head of pools immediately downstream of riffles where sub-surface flows may be emerging and affecting surface water quality. Rainbow trout/steelhead have been observed to congregate in these localized cooler areas during summer months. The localized cool water areas serve as refuges from exposure to elevated temperatures (>25 C), and allow successful oversummering under adverse temperature conditions.

Surface and bottom thermographs were deployed in 4 deep pool habitats at river miles 0.5, 7.8, 8.7, and 9.5. Bottom mean and maximum temperatures were the same or slightly cooler compared to surface temperatures at miles 0.5 and 7.8. At miles 8.7 and 9.5 bottom mean and maximum temperatures were nearly 2 C cooler when compared with surface temperatures. It is still unclear whether these cooler temperatures at miles 8.7 and 9.5 were the result of cool water upwelling or diel stratification within the pool habitat.

In 1996, surface and bottom thermographs were deployed at miles 0.5, 7.9, and 9.5 prior to WR 89-18 releases. Bottom mean and maximum temperatures were nearly identical compared to surface temperatures at mile 7.9. At mile 0.5, the bottom thermograph was deployed in a location where divers could feel cooler water. Bottom temperatures were 2.5-5.5 C cooler compared to surface temperatures. At mile 9.5 bottom temperatures were 3.5-6.5 C cooler compared to surface temperatures. Another vertical array was deployed at mile 6 where another cool upwelling area was suspected to exist. Unfortunately, the thermograph units were lost when the tree branch where they were attached was removed by beavers. Vertical arrays were deployed at several locations to monitor potential upwelling and the effects of WR 89-18 flows. Flows from WR 89-18 were sufficient to mix the water and mask any evidence of cool water upwelling.

Temperature Response to River Flow

Water temperature monitoring during the 1994 and 1996 WR 89-18 releases provided an opportunity to document seasonal changes in water temperature at various locations within the mainstem Santa Ynez River under conditions of controlled releases from Bradbury Dam, ranging from 50 to 140 cfs (additional data is continuing to be collected, but is not available for inclusion in this report).

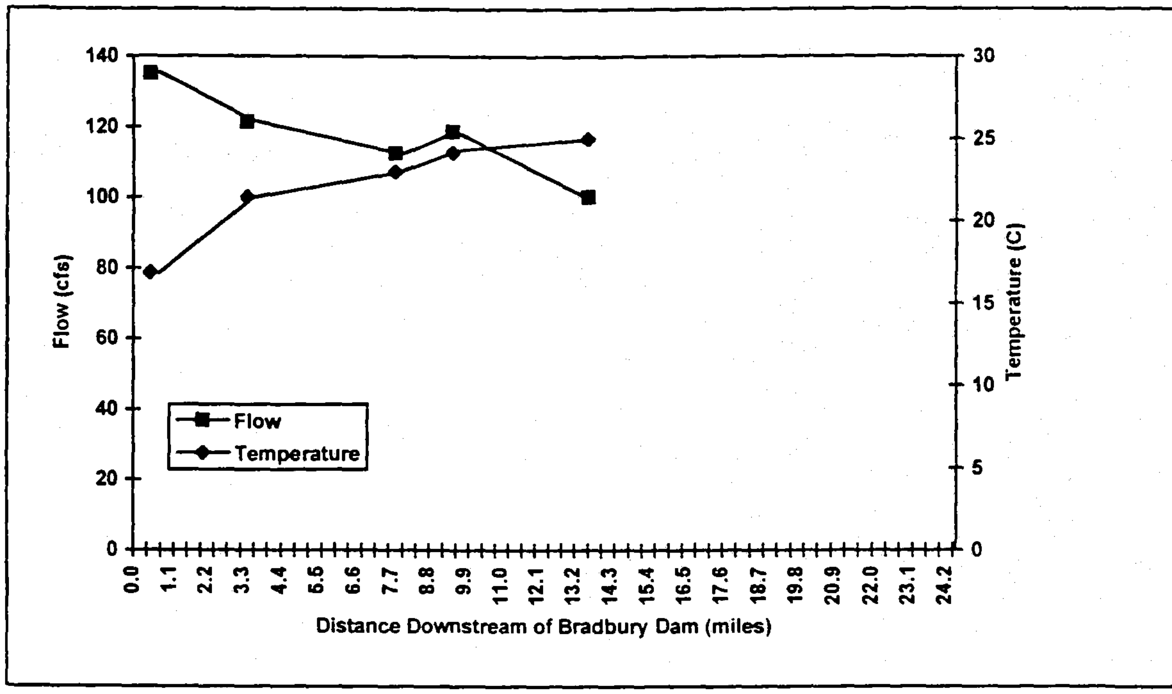
Water temperature was monitored during the 1994 WR 89-18 release within the downstream portion of the stilling basin near the transition with the Long Pool. Results of water temperature monitoring (Figure 3-36) showed a general pattern of seasonally increasing temperatures during the spring and summer, with maximum daily temperatures approaching 25 C. Daily variation during the April - July period was typically 3 - 4 C. Controlled releases began July 26, 1994, at a rate of approximately 140 cfs (Figure 2-7; Appendix B). Coincident with the initiation of the WR 89-18 release, water temperature declined rapidly from an average of approximately 22 C to approximately 14 C, an eight degree change in average daily temperature. The reduction from the maximum daily temperature immediately prior to the WR 89-18 release to the minimum temperature immediately after the release was approximately 10 C. In addition to the marked decline in water temperatures within the spill basin, the increase in releases also resulted in a substantial reduction in the daily temperature variation. Daily variation after initiation of the release was approximately 0.5 C, which remained relatively stable through August, September, and October. The effect of the 1994 controlled release on water temperatures within the spilling basin resulted in (1) a decline in the absolute water temperature, and (2) a decline in the daily variation in water temperature observed as part of this monitoring effort. A similar pattern in water temperature at the surface of the Long Pool was observed coincident to the initiation of the 1996 WR 89-18 release (Figure 3-37).

During the 1996 WR 89-18 releases, water flow was measured directly upstream of thermograph monitoring locations during the warmest portion of the day to determine what benefit large volume releases may have on summer water temperatures at various locations downstream from Bradbury Dam. Flow was measured between 1400-1600 hours at miles 3.4, 7.8, 9.5, 13.6, and 24 when releases from Bradbury were 135 cfs, 70 cfs, and 50 cfs (measurements were also made at 40 cfs, but the thermograph data has not been downloaded). A substantial reduction in surface water flows occurs during the WR 89-18 releases at downstream locations as the groundwater basin is recharged. For example, at 135 cfs release from the dam only about 75 cfs may reach mile 24. At 70 cfs, only about 35 cfs reaches mile 24.

Table 3-6 presents a summary of average daily temperatures at various monitoring locations before and after WR 89-18 releases reached the habitat unit during the summer of 1996. Water temperature in late July increased approximately 8-10 C between mile 0.5 and mile 24 at the 135 cfs release (Figure 3-38). At the 70 cfs release in the beginning of August, water temperature increased between 8-9 C from mile 0.5 to mile 24 (Figure 3-39). When water releases were 50 cfs, water temperature warmed approximately 8 C from mile 0.5 to mile 13.6 (Figure 3-40).

Surface and bottom water temperatures within the Long Pool declined after initiation of the WR 89-18 releases. The decline of water temperatures immediately below Bradbury Dam reflects the release of water from the reservoir having a lower temperature than seasonal water temperatures within the Long Pool. A time lag was observed between initiation of releases from the dam and the response in water temperatures downstream within the Long Pool which may reflect, in large part, the volume of the stilling basin and Long Pool, and thermal mixing which occurred within this area after initiation of the controlled releases. Water temperatures at the Buellton and Cargasachi sites increased coincident with the arrival of waters from the WR 89-18 release (Table 3-6). Increases in water temperatures at these locations may reflect warming of waters along the longitudinal gradient within the Santa Ynez River mainstem, disruption of thermal stratification which occurred within deeper downstream pool habitats, and may have masked the effects of cold groundwater upwelling at several of the downstream monitoring locations.

At all flow releases, water temperature increased quickly between the Long Pool (mile 0.5) and Refugio (mile 3.4; Figures 3-38 to 3-40). Despite having relatively cool water temperatures released from Bradbury Dam (approximately 17 C), a rapid increase in water temperatures was observed at release rates ranging from 50 to 135 cfs (Figures 3-38



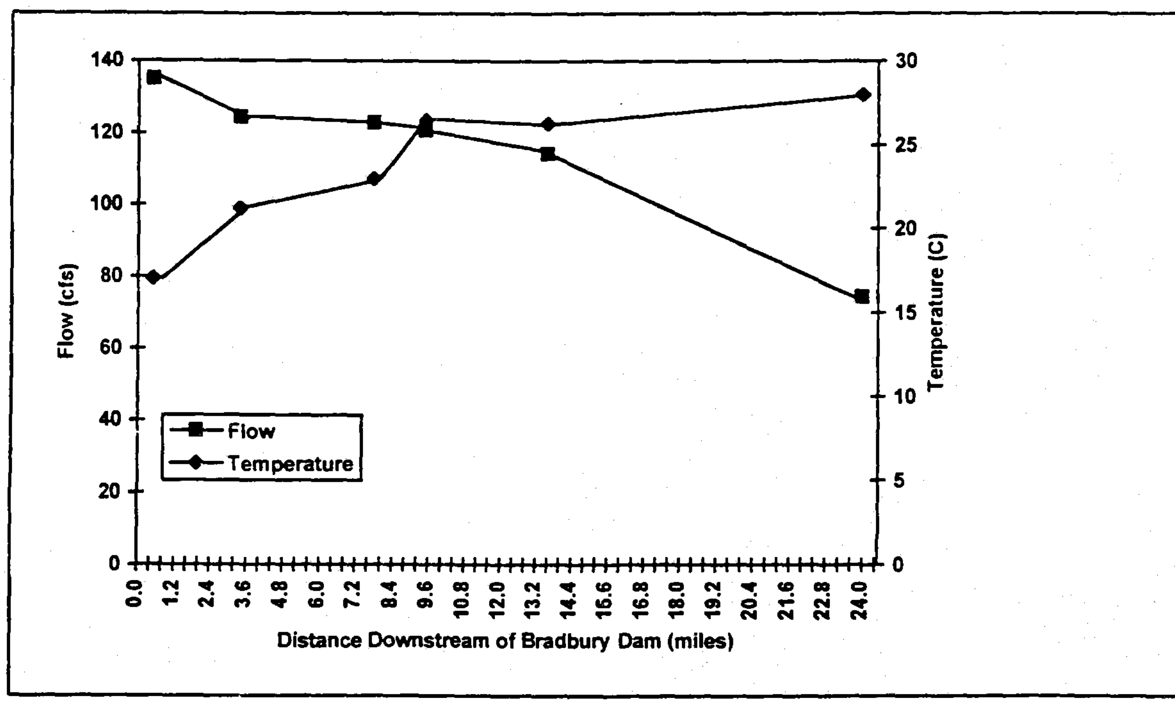
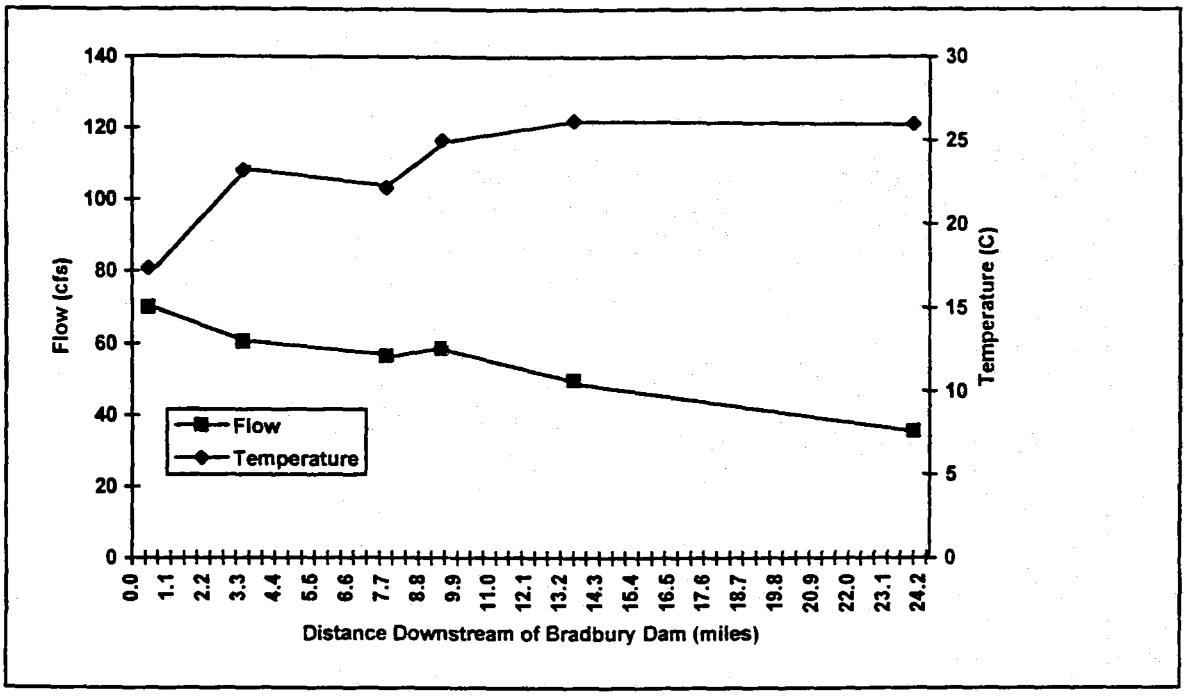


Figure 3-38. Longitudinal gradient in average daily water temperature and instream flow downstream of Bradbury Dam during the 1996 WR 89-18 release of 135 cfs, July 25, 1996, and July 28, 1996.



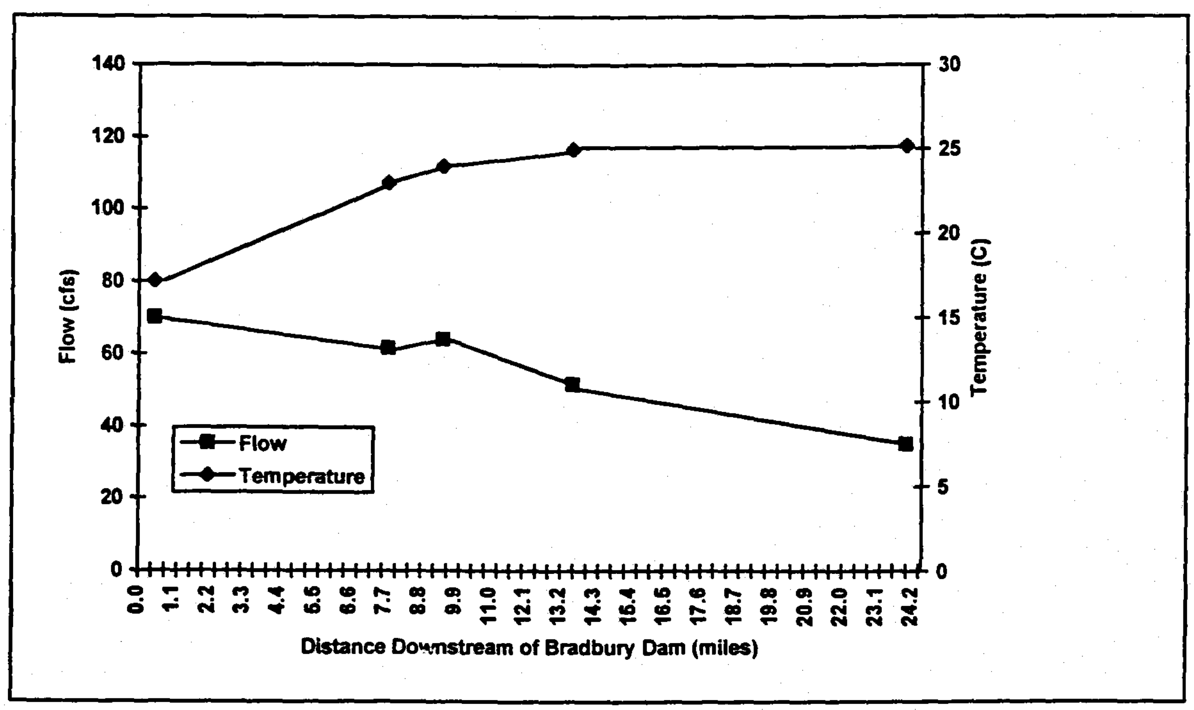


Figure 3-39. Longitudinal gradient in average daily water temperature and instream flow downstream of Bradbury Dam during the 1996 WR 89-18 release of 70 cfs, August 4, 1996, and August 9, 1996.

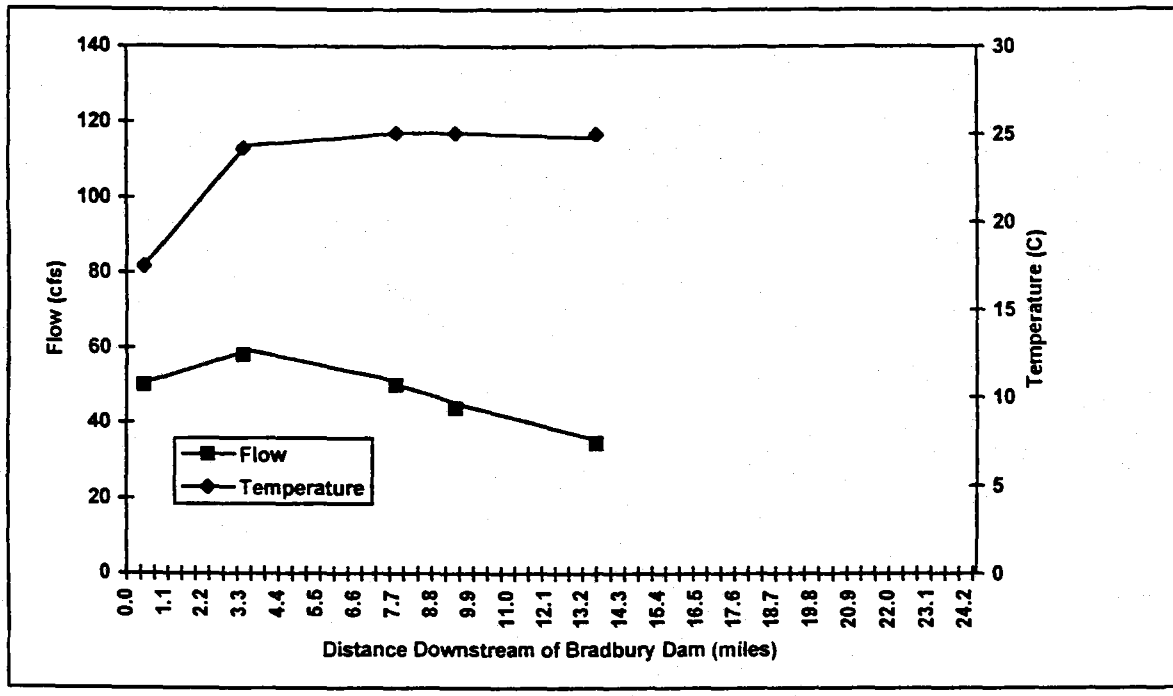


Figure 3-40. Longitudinal gradient in average daily water temperature and instream flow downstream of Bradbury Dam during the 1996 WR 89-18 release of 50 cfs, August 28, 1996.

Table 3-6. **Minimum and maximum average daily water temperatures measured at various locations within the Santa Ynez River, immediately before and after 1996 WR 89-18 releases.**

	Before	After
Long Pool Surface		
Date	6/29-7/17	7/18-8/16
Temperature (C)	21.0-25.0	15.8-17.8
Long Pool Bottom		
Date	6/29-7/17	7/18-8/16
Temperature (C)	18.0-18.6	15.8-17.0
Refugio X (3.4 miles)		
Date	Dewatered	7/19-8/15
Temperature (C)	-	15.9-24.2
Alisal 45 (7.8 miles)		
Date	7/9-7/20	7/20-8/9
Temperature (C)	18.6-19.6	17.0-25.1
Alisal 9 Surface (9.5 miles)		
Date	7/9-7/21	7/22-8/9
Temperature (C)	21.0-27.0	17.0-27.3
Alisal 9 Bottom (9.5 miles)		
Date	7/9-7/21	7/22-8/9
Temperature (C)	19.4-22.5	17.0-27.1
Buellton (13.6 miles)		
Date	7/9-7/22	7/23-8/9
Temperature (C)	18.2-23.7	18.8-27.5
Cargasachi (24 miles)		
Date	7/9-7/26	7/26-8/9
Temperature (C)	18.0-22.8	20.0-28.0

Note: **Minimum water temperatures were lower after initiation of WR 89-18 releases between the dam and Alisal Unit 9 (9.5 miles downstream).**

to 3-40). The rapid increase in water temperatures between the Long Pool and Refugio (mile 3.4) over the range of flows released from Bradbury Dam reflects, in part, the influence of high ambient air temperature during the summer months on water temperatures within the Santa Ynez River. Other factors interacting with air temperature to influence Santa Ynez River water temperatures at downstream locations include the relatively broad channel width, shallow water depth, and lack of riparian vegetation providing shading along the stream corridor.

The river reach between Bradbury Dam and Refugio (3.4 miles), in contrast to much of the lower river, has well developed riparian vegetation along the stream corridor which provides shading. Despite shading and relatively high instream flows during the WR 89-18 releases, water temperatures increased rapidly within the first three to five miles downstream of Bradbury Dam (Figures 3-38 - 3-40). Results of these studies showed that potentially adverse water temperatures occur at locations 3.4 miles and further downstream of the dam during the summer, despite instream flow releases of 50 to 135 cfs.

Despite the release of relatively large flows from Bradbury Dam (up to 135 cfs) during the WR 89-18 release water temperatures at downstream locations remained at relatively high levels. Additional temperature monitoring, over a range of river flow conditions and seasonally varying ambient air temperatures, will provide a stronger foundation for assessing the potential relationship between controlled releases of various magnitudes and subsequent average daily and maximum water temperatures at downstream locations. As a result of the management strategy for WR 89-18 releases, the surface water flows did not extend downstream of Lompoc during 1996, and hence would not have a direct influence on surface water temperatures within the lower reach of the river or lagoon. The influence of the 1996 WR 89-18 releases on cool groundwater upwelling in various habitats could not be determined.

Mainstem Santa Ynez River Temperature Modeling

Temperature modeling has been performed on the Santa Ynez River downstream of Bradbury Dam in an effort to develop predictions regarding (1) the effects of various instream flow releases on seasonal water temperatures occurring downstream of the dam, and (2) to predict the effects of such factors as instream flow releases on the geographic area extending downstream from the dam, which would provide acceptable and suitable habitat conditions for various lifestages of rainbow trout/steelhead. The earliest temperature modeling was performed by Jack Rowell (U.S. Bureau of Reclamation) who developed a statistical regression model for use in estimating downstream water temperatures. This early temperature model was derived based on limited water temperature monitoring results from various locations within the Santa Ynez River. The model generally predicted that suitable summer water temperatures for rainbow trout/steelhead would be limited to the upper 3-5 miles of the Santa Ynez River below Bradbury Dam.

A more sophisticated effort to model Santa Ynez River water temperatures was compiled as part of the Cachuma Project Contract Renewal Environmental Impact

Statement/Environmental Impact Report (Entrix 1995). This modeling effort utilized the U.S. Fish and Wildlife Service SSTEMP model, which also included predictions of solar radiation and day length for the Santa Ynez River basin and stream shading based on topography and characteristics of riparian vegetation. Data used in the modeling included meteorological data on solar radiation, air temperature, relative humidity, sunshine, and wind speed. Hydrologic data included discharges from Bradbury Dam and Santa Ynez River tributaries, initial water temperature at the dam and tributaries, and estimates of temperature influences by groundwater and storm water runoff. The model also included consideration of stream geometry including elevations and distances, stream width, stream shading, and hydraulic gradients. The model was calibrated using water temperature data collected in the Long Pool (0.3 miles downstream of Bradbury Dam), San Lucas Ranch (1 mile downstream), and Alisal Bridge in Solvang (9.8 miles downstream). The model predicted, on average, water temperatures that were in general agreement with those collected in the field.

The temperature simulation model compiled for the Santa Ynez River below Bradbury Dam was used by Entrix (1995) to evaluate average daily water temperatures at various locations downstream of Bradbury Dam, and the distance downstream within which average daily water temperatures were less than 20 C, under various alternative instream flow release scenarios. The simulation model assumed that a hypolimnetic withdrawal would occur from Cachuma Reservoir to take advantage of cooler water temperatures during the summer, occurring in the lower portion of the reservoir water column (Figures 3-3 - 3-5). Water temperatures using the simulation model were developed for the period May through September at the stilling basin (0 miles downstream of the dam), Long Pool (0.3 miles), San Lucas Ranch (1.0 miles), Refugio Road Bridge (7.4 miles), and Alisal Road Bridge (9.9 miles). Instream flow releases assumed in the simulation model varied among alternatives and months within a range (estimated for San Lucas Ranch, 1.0 miles downstream of Bradbury Dam) from 1.1 to 25.3 cfs. Flows assumed in the simulation model declined as a function of distance downstream from Bradbury Dam, which is consistent with actual flow data measured within the river (Figures 3-38-3-40).

Results of these simulation analyses showed (1) a seasonal pattern of increasing water temperatures during the summer months (with greatest water temperatures occurring during July and August), (2) a pattern of increasing water temperatures as a function of distance downstream from Bradbury Dam, (3) the distance downstream from Bradbury Dam within which average daily water temperatures were less than 20 C, ranging among alternatives from 0.33 to 4.45 miles in July, and from 0.18 to 1.0 mile in August. Water temperatures were consistently less than 20 C among all alternatives throughout the 9.9 mile reach included in the simulation analysis during May and June, (4) average daily water temperatures less than 22 C were predicted to extend throughout the 9.9 mile reach, with the exception of July when flow releases were assumed to be 3.2 and 2.5 cfs in two of the alternatives analyzed, and in August under an assumed daily flow at San Lucas Ranch of 1.8 cfs, and (5) average daily water temperatures at all locations and stream flows included in the simulation analysis were less than 24 C throughout the 9.9 mile reach between May and September.

Results of the simulation model are generally consistent with observations of the longitudinal gradient in temperatures occurring within the lower Santa Ynez River and the seasonal periods and locations where the highest summer water temperatures occur. Results of the simulation model may be biased since data collected in 1993 was used in calibration, and 1993 represented extreme meteorological conditions. Based on air temperatures, Entrix (1995) reported that the summer of 1993 was one of the warmest on record. Entrix (1995) acknowledged that the use of an extreme data set for calibration may result in some predictive bias for other environmental conditions, compared with the same model calibrated to more varied or more normal meteorological conditions within the Santa Ynez River basin.

Additional data from water temperature monitoring over a range of instream flow and ambient air temperature conditions are now available, including water temperature data collected coincident with the 1996 WR 89-18 releases which were not available for use as part of earlier modeling efforts. In addition, statistical analyses have been performed to evaluate water temperature conditions at locations downstream of Bradbury Dam in terms of their suitability as habitat for rainbow trout/steelhead based on average daily water temperature and maximum daily water temperature utilizing data collected in 1995 - 1996 (see discussion above).

Additional refinements in water temperature modeling can be made to reflect variation in atmospheric conditions, stream flow, and reservoir operations (utilizing actual field data collected over the 1993-1996 period). However, prediction of both the statistical models and simulation model have been consistent with field observations in identifying the 1-3 mile reach of the river immediately below Bradbury Dam as the best available habitat, based upon temperature considerations for rainbow trout/steelhead, within the lower mainstem Santa Ynez River below Bradbury Dam. The presence of rainbow trout/steelhead at downstream locations (e.g., Alisal) during the summer shows that other factors such as localized cool groundwater upwelling, greater thermal tolerance for southern populations of rainbow trout/steelhead, availability of food resources, and other factors influence habitat suitability at specific locations which are not taken into account in the more general analyses of longitudinal temperature gradients within the river.

3.3 Santa Ynez River Mainstem Dissolved Oxygen

Diel Fluctuations

During late spring and extending into early fall, the Santa Ynez River exhibits tremendous algae production in most of its surface waters. This abundant algal growth can contribute to substantial diel variation in dissolved oxygen concentrations and may adversely affect habitat quality for resident fish. During the day when photosynthesis is taking place, algae production can saturate the water with dissolved oxygen, particularly during summer. Conversely, during the dark hours, algae metabolism, bacterial decomposition, and invertebrate respiration can remove significant amounts of dissolved oxygen from overlying water causing oxygen depletion.

Salmonids function normally at dissolved oxygen concentrations of 6-8 mg/l; exhibit various distress symptoms at 5-6 mg/l; and are often negatively affected at 4 mg/l or less (Barnhardt 1986). Warm water species, such as largemouth bass, and cool water species like salmonids may be able to survive when dissolved oxygen concentrations are relatively low (<5 mg/l), but growth, food conversion efficiency, and swimming performance will be adversely affected (Bjornn and Reiser 1991, Piper et al 1982). High water temperatures, which reduce oxygen solubility, compound the stress on fish caused by marginal dissolved oxygen concentrations (Bjornn and Reiser 1991).

To evaluate the potential for diel fluctuations in dissolved oxygen concentrations within various habitat areas of the Santa Ynez River, dissolved oxygen surveys were initiated in 1993, and have continued until 1996. Dissolved oxygen concentrations and water temperature measurements have been made using Yellow Springs Instruments (YSI) Model 55 and Model 57 Dissolved Oxygen and Temperature Meters. Surveys have been conducted by measuring temperature and dissolved oxygen at both the surface and throughout the water column of deeper habitat areas. Surveys are typically done using paired sets of measurements, with the first survey being performed during the pre-dawn period to ensure measurements of the lowest dissolved oxygen concentrations during the 24-hour period. The second survey is made during the late afternoon to ensure measurement of the highest dissolved oxygen concentrations during the 24-hour period. Results of these diel surveys of dissolved oxygen are summarized below.

During 1993, dissolved oxygen concentrations in the mainstem were measured at stream flow releases from Bradbury Dam of approximately 10 cfs on July 8 and 9, 5 cfs on October 13 and 14, and 1 cfs on November 9 between the stilling basin (mile 0.25) and Highway 154 Bridge (mile 3.0). Large diel fluctuations were observed in dissolved oxygen concentrations between morning and evening surveys (Table 3-7). Results of the preliminary 1993 surveys indicated that dissolved oxygen concentrations at the one habitat unit (Site 15; Table 3-7) monitored in July when releases from Bradbury Dam were 10 cfs was 2.6 mg/l during the early morning survey. Results of subsequent surveys showed that early morning dissolved oxygen concentrations at Site 4 ranged from 1.8 to 2.4 mg/l, although dissolved oxygen concentrations were slightly higher at Site 15 (3.0-4.0 mg/l) and Site 2 (3.5-7.6 mg/l). Dissolved oxygen concentrations were all substantially higher during the late afternoon surveys (greater than 6 mg/l). Visual observations made during the surveys indicate that large algae mats were covering the surface of several large pools upstream of Highway 154 Bridge which are thought to have contributed to the observed diel fluctuations in dissolved oxygen concentrations. The diel fluctuations in dissolved oxygen concentrations observed during the 1993 surveys would have contributed to physiological stress and reduced habitat suitability for rainbow trout/steelhead and other fish species inhabiting the Santa Ynez River.

In 1995, diurnal dissolved oxygen and temperature monitoring was conducted on August 23, September 20, and October 31. Figure 3-38 presents an example of the vertical temperature and dissolved oxygen profiles observed during the summer and fall of 1995. The lowest dissolved oxygen measurements during the three diurnal surveys were recorded in August at Sites 2 (Refugio X at mile 3.4), 3 (Alisal Unit 48 at mile 7.8), and 4 (Alisal Unit 45 at mile 7.9) (Table 3-8). Morning dissolved oxygen concentrations in August at these three locations ranged from less than 1 to 2.86 mg/l. The low dissolved oxygen concentrations, particularly those observed at Site 4 (mile 7.9), which were less than 1.7 mg/l, would be expected to result in acute mortality for rainbow trout/steelhead and most other fish species inhabiting the Santa Ynez River. Despite the low dissolved

Table 3-7. **Dissolved oxygen[1] and water temperature measured during fisheries sampling within the Santa Ynez River, 1993.**

Date	Time	Site 2 D.O. (ppm)	Site 2 Temp (C)[2]	Site 3 D.O. (ppm)	Site 3 Temp (C)	Site 4 D.O. (ppm)	Site 4 Temp (C)
8 July	0520	N/S[1]	N/S	N/S	N/S	2.6	16.9
9 July	1530	N/S	N/S	N/S	N/S	10.1	23.1
13 October 1993	1710	12.8	18.1	4.6	18.1	8.0	21.1
	1720	13.6	18.1	4.0	18.1	7.0	21.1
	1730	13.6	18.1	4.6	18.1	7.0	21.1
	1740	13.2	18.1	4.0	18.1	6.0	20.6
	1750	14.0	18.1	3.8	18.1	6.0	20.6
	1800	13.8	18.1	3.8	18.1	6.0	20.0
14 October 1993	0530	7.6	16.7	2.4	18.1	3.6	18.9
	0540	7.6	16.7	2.0	17.8	3.8	18.9
	0550	7.5	16.9	1.8	17.8	3.8	18.9
	0600	7.5	16.9	1.8	18.1	3.8	18.9
	0610	7.4	16.9	1.8	18.1	3.8	18.9
	0620	7.4	16.9	1.8	18.1	4.0	18.9
9 November 1993	0515	5.77	14.8	2.20	11.1	3.0	16.9
	0525	4.88	14.8	2.25	11.1	3.2	16.9
	0535	5.38	14.8	2.25	11.1	3.2	16.9
	0545	3.50	14.8	2.20	11.1	3.1	16.9
	0555	4.85	14.8	2.15	11.1	3.2	16.9
	0605	4.21	14.8	2.10	11.1	3.0	16.9
9 November 1993	1545	8.48	16.9	9.0	18.5	6.8	19.1
	1555	7.30	16.9	12.0	18.5	6.8	19.1
	1605	7.80	16.9	11.5	18.5	6.4	18.9
	1615	8.77	16.9	12.0	18.5	6.6	18.9
	1625	7.72	16.9	12.0	18.5	6.2	18.7
	1635	8.05	16.9	11.0	18.5	6.2	18.3

[1]N/S - not sampled.
[2]Original measurements recorded in degrees Fahrenheit.

Table 3-8. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1995.

August, 1995

Site 1, Long Pool mid-portion, River Mile 0.5, 30% algal cover
23-Aug (4.5 cfs, recorded at Bradbury Dam)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0615-0620	1820-1828	0615-0620	1820-1828
0	19.84	22.18	10.49	12.45
1	19.88	22.19	10.44	12.47
2	19.87	22.02	10.32	12.67
3	19.72	21.01	9.06	12.77
4	19.31	20.29	6.54	16.62
5	19.08	20.07	6.57	16.5
6	19.09	19.95	6.07	16.43
7	19.28	19.91	5.06	16.5
7.5	*	19.88	*	16.38

Site 2, Refugio X Site, River Mile 3.4, 40% algal cover
23-Aug (Santa Ynez Gage not operating)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0519-0523	1755-1801	0519-0523	1755-1801
0	20.9	24.8	2.85	11.35
1	20.9	24.1	2.79	9.92
2	20.9	21.6	2.74	3.62
3	20.9	21.4	2.67	2.69

Site 3, Alisal Road, River Mile 7.8, 40% algal cover
23-Aug (0 cfs, recorded at Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0548-0555	1817-1824	0548-0555	1817-1824
0	20.7	26	2.33	> 17.0
1	20.8	23.8	2.1	8.51
2	20.8	23.7	2.07	8.19
3	20.8	23.4	2.23	7.56
4	20.8	21.7	2.22	4.3
4.5	20.8	21.7	2.18	3.9

Table 3-8. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1995 (continued).

Site 4, Alisal Road, River Mile 7.9, 60% algal cover
23-Aug (0 cfs, recorded at Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0604-0621	1628-1633	0604-0612	1628-1633
0	20	23.9	1.66	7.91
1	20.4	21.2	1.57	3.68
2	19.9	20.4	1.15	2.55
3	17.7	18.3	0.15	1.7
3.5	17.5	18.3	0.011	1.32

Site 5, Cargasachi Ranch, River Mile 24, 0% algal cover
24-Aug (12 cfs, recorded at Lompoc)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	600	1320	600	1320
0-1	18.91	23.35	6.07	8.75

Site 6, 13th Street Bridge, River Mile 43, 0% algal cover
24-Aug

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0609-0611	1240	0609-0611	1240
0	17.5	24	7.43	10.23
1	17.5	*	7.37	*

Table 3-8. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1995 (continued).

September, 1995

Site 1, Long Pool mid-portion, River Mile 0.5, 40% algal cover
21-Sep (4.5 cfs, recorded at Bradbury Dam)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0638-0643	1633-1638	0638-0643	1633-1638
0	19.1	21	10.5	12
1.6	19.1	21	10.5	12
3.2	19	19.8	8.5	13
4.8	18.7	19.3	6.5	13.5
6.4	18.5	19.3	0.3	13.5
8	18.5	19.5	5.1	13

Site 2, Refugio X Site, River Mile 3.4, 40% algal cover
20-Sep (Santa Ynez Gage not operating)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0622-0627	1617-1620	1617	1620
0	19	25.8	4.5	12.61
1	19	25.8	4.44	12.6
2	19	25.5	4.39	12.65
3	19	24	4.39	10.79

Site 3, Alisal Road, River Mile 7.8, 40% algal cover
20-Sep (0cfs, recorded at Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0642-0648	1641-1648	0642-0648	1641-1648
0	19.8	24.7	2.34	11.88
1	19.8	23.7	2.24	10.8
2	19.8	22.5	2.4	8.61
3	19.7	20.4	2.59	5.05
4	19.6	20.2	2.65	4.09

Table 3-8. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1995 (continued).

Site 4, Alisal Road, River Mile 7.9, 45% algal cover
20-Sep (0cfs, recorded at Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0653-0658	1654-1658	0653-0658	1654-1658
0	20.1	22.8	2.33	9.08
1	20.1	22.1	2.2	7.06
2	19.9	20.7	1.86	4.68
3	18.5	19	0.29	3.45

Site 5, Cargasachi Ranch, River Mile 24, 0% algal cover
21-Sep (0cfs, recorded at Lompoc)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	610	1518	610	1320
0-1	18.7	24.5	9.6	13

Site 6, 13th Street Bridge, River Mile 43, 0% algal cover
21-Sep

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0619-0621	1600	0619-0621	1240
0	17.2	*	7.67	*
1	17.2	22.2	7.65	9.3

Table 3-8. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1995 (continued).

October, 1995

Site 1, Long Pool mid-portion, River Mile 0.5, 40% algal cover
31-Oct (4.5 cfs, recorded at Bradbury Dam)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0621-0628	1542-1553	0621-0628	1542-1553
0	16.6	17.5	11.08	12.7
1	16.6	17.3	11.04	12.7
2	16.6	17.3	11.01	12.6
3	16.5	17	10.8	12.3
4	16.3	16.9	8.58	12
5	16.2	16.7	8.03	11.3
6	16.1	16.5	7.9	10
7	16.1	16.2	7.73	9.8
8	*	16.1	*	9.5

Site 2, Refugio X Site, River Mile 3.4, 5% algal cover
31-Oct (Santa Ynez Gage not operating)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0602-0610	1617-1620	0602-0610	1617-1620
0	17.2	18.9	7.4	14.02
1	17.2	18.9	7	13.93
2	17.2	18.8	6.8	13.63
3	17.2	18.8	6.4	13.43

Site 3, Alisal Road, River Mile 7.8, 15% algal cover
31-Oct (0.9 cfs, recorded at Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0620-0625	1640-1646	0620-0625	1640-1646
0	18	19.2	7	9.37
1	18	19.2	7	9.27
2	18	19.2	6.8	9.05
3	18	19.1	5	8.86
4	18	19.2	4.8	9.33

Table 3-8. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1995 (concluded).

Site 4, Alisal Road, River Mile 7.9, 80% algal cover
31-Oct (0.9 cfs, recorded at Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0630-0635	1648-1653	0630-0635	1648-1653
0	18	19.2	6.7	8.67
1	18	19.2	6.8	8.52
2	18	19.2	6.2	8.38
3	18	19.2	5.6	8.07

Site 5, Cargasachi Ranch, River Mile 24, 0% algal cover
31-Oct (5.6 cfs, recorded at Lompoc)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	740	1400	740	1400
0-1	16.8	21.9	7.84	11.24

Site 6, 13th Street Bridge, River Mile 43, 0% algal cover
31-Oct

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	732	1500	732	1500
0-1	16.5	20.2	8.4	9.2

oxygen concentrations, rainbow trout/steelhead were observed between August and October (although in decreasing numbers) at Alisal Habitat Units 45 and 48 and Refugio Unit X. No rainbow trout/steelhead were observed at diurnal Site 3 in November, however, rainbow trout/steelhead were present at other areas during the August - November, 1995 surveys. Percent surface algae coverage at each Site was 40%, 40%, and 65% respectively. Site 4 (Alisal Road) in August had the lowest oxygen readings for the morning hours with 1.66 mg/l at the surface, and 0.01 mg/l at 3.5 feet. Site 3 recorded the next lowest with morning readings of 2.33 mg/l down to 2.18 mg/l at 3 feet. Site 2 readings ranged from 2.85 mg/l down to 2.67 mg/l. Conversely, evening dissolved oxygen at Sites 2, 3, and 4 were high at the surface (7.91 mg/l at Site 3 to >17 mg/l at Site 2), but dissolved oxygen remained low from the mid-water column to the bottom (3.9 mg/l at Site 3 to 2.69 mg/l at Site 2). Site 1 (Long Pool), Site 5 (Cargasachi Ranch, mile 24), and Site 6 (13th Street, mile 42) had moderate to high amounts of morning dissolved oxygen ranging from 5.06 mg/l to 10.49 mg/l (Table 3-8).

Results of both temperature and dissolved oxygen measurements during August, 1995, are consistent with the hypothesis that vertical stratification becomes established within deeper pool habitats during the summer months (see Figure 3-41) in the absence of significant flow. For example, vertical gradients in both dissolved oxygen and water temperature occurred during the afternoon surveys in August, 1995, at Sites 2, 3, and 4 (Table 3-8). At all three locations, water temperature and dissolved oxygen concentrations were greatest near the surface and declined with depth. The apparent vertical stratification at these habitats during the summer would present a potential conflict in habitat selection by species such as rainbow trout/steelhead in which areas of the habitat having sufficient dissolved oxygen concentrations may also have elevated, and potentially stressful, water temperature conditions. Temperature and dissolved oxygen were relatively uniform throughout the water column (Table 3-8, Figure 3-42) during the fall months. The potential for diel migration of rainbow trout/steelhead based on water temperature and dissolved oxygen conditions within a habitat is discussed in Section 5.

Morning dissolved oxygen measurements recorded in September were slightly higher at Sites 2, 3, and 4, but were still below 4.5 mg/l (Table 3-8). Percent surface algae coverage was 40%, 50%, and 45 % respectively. Diel stratification was still evident at Sites 2 and 3 during the evening in September. Measurements at Sites 1, 5, and 6 were essentially the same as August (Table 3-8).

By October 1995, early morning dissolved oxygen measurements had increased above 5.0 mg/l except at the bottom of Site 3 (4.8-5.0 mg/l). Percent algae coverage at Sites 2,3, and 4 was 5%, 15%, and 80% respectively. Temperature measurements were cool and uniform during both morning and evening surveys with both less than 20°C. Dissolved oxygen concentrations remained high in the evenings varying between 2-7 mg/l higher at all Sites when compared to the morning hours. Cooler air temperatures, less sunlight, and a decrease in surface algae during October correlate with lower evening water temperatures and higher morning dissolved oxygen concentrations.

Prior to the 1996 WR 89-18 water releases, much of the mainstem river began to dry beginning in May. Some small pool habitats remained where monitoring was performed in 1996. Diurnal dissolved oxygen profiles were measured on April 15, July 16, August

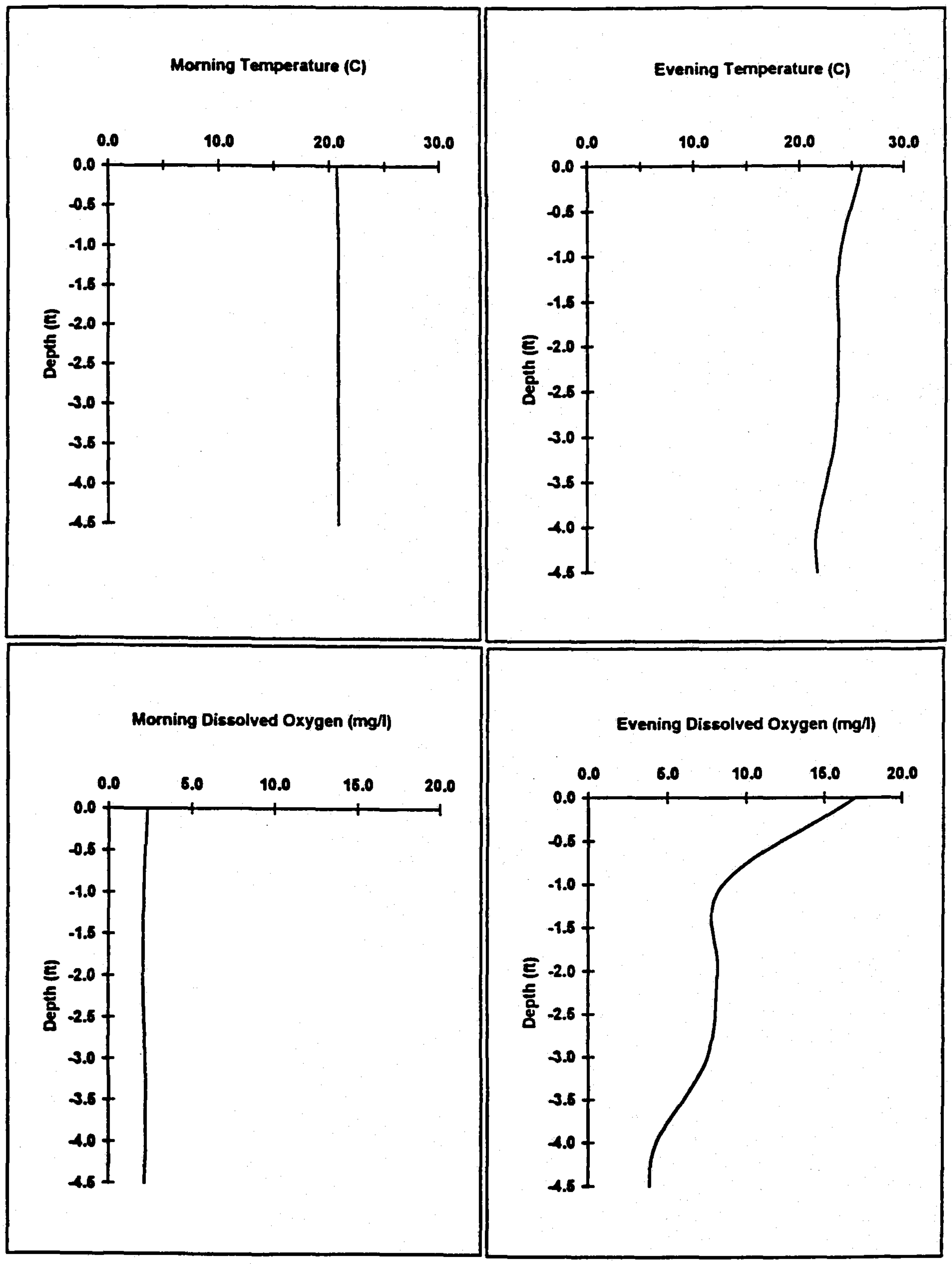


Figure 3-41. Vertical profiles in water temperature and dissolved oxygen concentrations measured during morning and evening hours at Alisal Road (mile 7.8) on August 23, 1995.

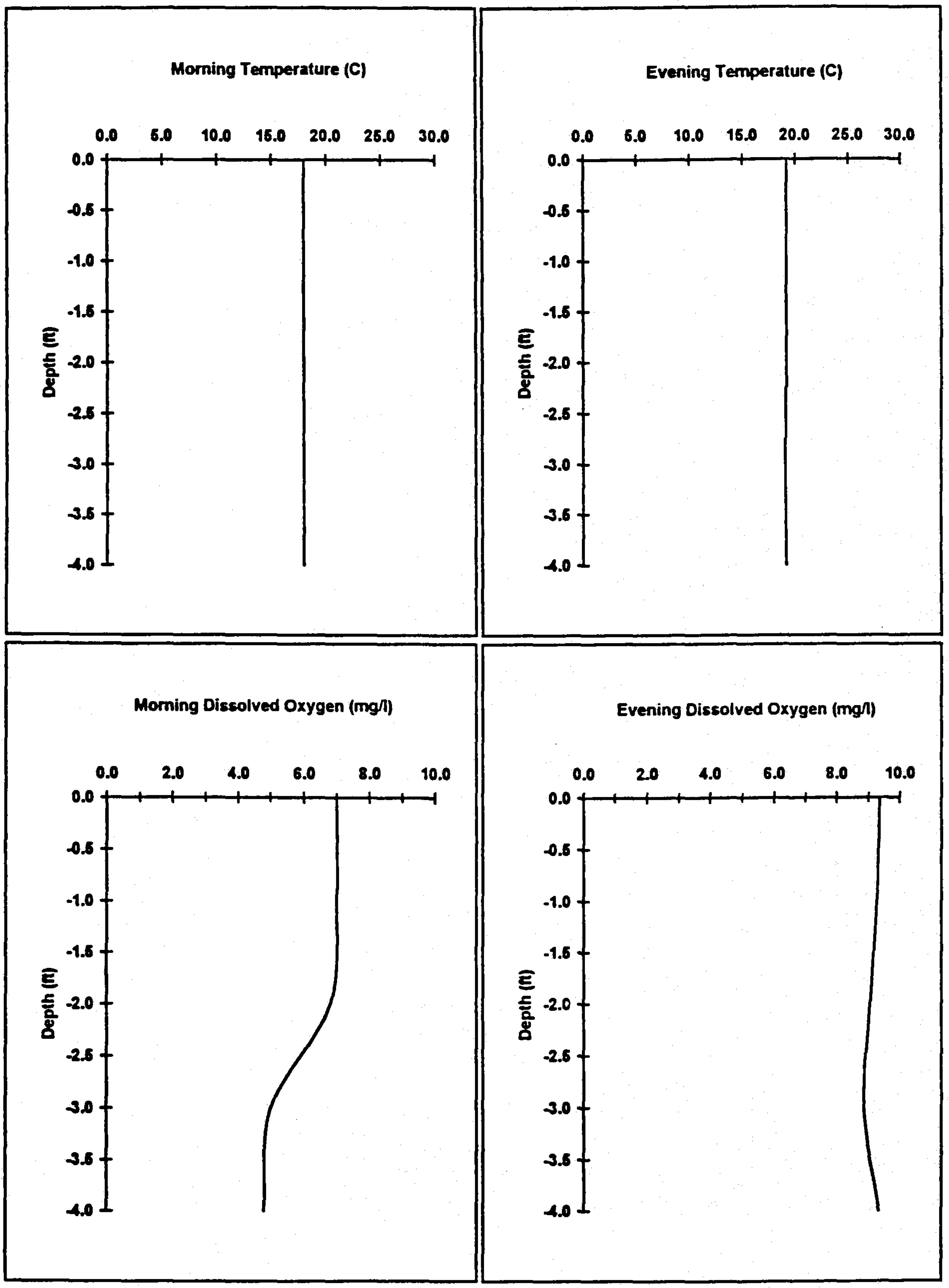


Figure 3-42. Vertical profiles in water temperature and dissolved oxygen concentrations measured during morning and evening hours at Alisal Road (mile 7.8) on October 31, 1995.

2 and 17, and September 17 (Table 3-9). All surveys with the exception of the July 16 survey measured dissolved oxygen concentrations in the morning hours in excess of 6 mg/l. Evening dissolved oxygen concentrations were generally in excess of 8.0 mg/l in all surveys except on July 16. Figure 3-43 presents an example of temperature and dissolved oxygen profiles at the Alisal Road (mile 7.8) monitoring station during the spring (April) prior to WR 89-18 releases, and during September (Figure 3-44).

The July 16 survey measured morning dissolved oxygen concentrations < 1.0 mg/l at the bottom of pool habitats at mile 6 (new Site), mile 7.8 (Site 2 1995), and mile 13.6 (new Site). Evening dissolved oxygen levels at these locations were 6.62 mg/l, 0.23 mg/l, and 13.83 mg/l respectively (Table 3-9).

After 1996 WR 89-18 water releases were initiated, monitoring was performed at three flow intervals 135, 70, 50. At no time did dissolved oxygen concentrations decline below 7 mg/l during either the morning or evening surveys. River flow provided by the WR 89-18 releases was sufficient to remove much of the algae from the remaining pool habitats and create sufficient turbulence and mixing to sustain higher dissolved oxygen concentrations throughout the day and night.

Dissolved Oxygen in Response to River Flows

Only in 1995 and a portion of 1996 did the mainstem river have sufficient water to monitor a longitudinal dissolved oxygen gradient. Monitoring during 1993 and 1994 was insufficient to evaluate a response between dissolved oxygen and flow at various locations. High rainfall and runoff allowed water to flow through the majority of the river in 1995. In the summer of 1995, several locations between Highway 154 bridge (mile 3.0) and Avenue of the Flags Bridge in Buellton (mile 13.6) went dry. Conversely, the river below Buellton continued to flow throughout the year. In 1996, beginning in May and continuing through to July, the river began to dry in both the upper and lower reaches.

In 1995, differences in algae production were observed between the upstream and downstream reaches. Upstream of Buellton, larger pool surface area, and minimal flow into habitat units allowed surface algae to accumulate within the pools. This algae, as described above, can remove large quantities of oxygen from the water during summer as seen at the Refugio and Alisal Road sample Sites (Table 3-8). Conversely, data gathered from sample Sites at the Cargasachi Ranch and 13th Street Bridge, which continued to have flowing water through the year had minimal deep pool habitats, and sustained moderate to high dissolved oxygen concentrations.

In 1996, the majority of the Santa Ynez River was dewatered which prevented algae accumulation. After WR 89-18 water releases began in July, diurnal surveys were conducted at 135, 70, 50, and 40 cfs. None of the monitoring locations (identical to 1995) recorded dissolved oxygen concentrations less than 7 mg/l during the critical morning hours at any of the flows tested. High flows both upstream and downstream prevented algae accumulation in low velocity habitats. The high flows also provided sufficient aeration.

Table 3-9. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1996.

April, 1996

Site 2, Refugio X Site, River Mile 3.4, 0% algal cover
14-Apr (5.7 cfs, recorded at Santa Ynez)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0630-0635	1515-1520	0630-0635	1755-1801
0	15.9	25.1	6.98	11.88
1	15.7	25	7.12	11.8
2	15.7	24.5	7.12	11.95
3	15.7	21.4	7.12	12.99

Site 3, Alisal Road, River Mile 7.8, 0% algal cover
15-Apr (5.1 cfs, recorded at Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0648-0653	1545-1550	0648-0653	1545-1550
0	15.7	24.5	6.23	12.07
1	15.5	24.5	6.33	12.09
2	15.5	24.5	6.39	12.04
3	15.5	24.4	6.39	11.93

Site 4, Alisal Road, River Mile 7.9, 0% algal cover
15-Apr (5.1 cfs, recorded at Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0700-0705	1600-1605	0700-0705	1600-1605
0	15.3	24.1	6.54	11.65
1	15.3	24.1	6.44	11.51
2	15.3	24	6.53	11.57
3	15.3	24	6.52	11.6
4	15.3	23.9	6.49	10.2

Site 5, Cargasachi Ranch, River Mile 24, 0% algal cover
15-Apr (0 cfs, recorded at Lompoc)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	745	1230	745	1230
1	15.2	20.8	8.56	10.6

Table 3-9. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1996 (continued).

July, 1996

Site 1, Long Pool mid-portion, River Mile 0.5, 80% algal cover
16-Jul (2.5 cfs, recorded at Bradbury Dam)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0545	1630	0545	1630
0	21.4	25.5	8.6	12.2
1	21.5	23.5	10.2	12.0
2	21.5	22.0	10.6	11.6
3	21.2	20.9	10.6	10.0
4	20.0	20.0	8.5	8.6
5	19.8	19.5	8.6	7.6
6	19.2	19.2	7.9	6.6
7	19.1	19.0	7.0	5.6
8	19.0	18.9	6.2	4.8
9	19.0	18.9	5.6	4.2
9.5	19.0		5.6	

Site 2, Refugio X Site, River Mile 3.4, algal cover N/A
16-Jul (2.5 cfs, recorded at Bradbury Dam: no data for Santa Ynez or Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0610	N/A	0610	N/A
0	21.8	25.5	13.7	12.1
1	21.6	24.0	13.8	12.6
2	21.6	22.1	13.6	12.6
3	21.4	21.0	13.4	10.3
4	20.2	20.0	10.8	8.4
5	19.5	19.6	10.0	6.8
6	19.3	19.3	9.2	6.3
7	18.9	19.0	8.4	4.5

Site 2, Refugio X Site, Beaver Pool, algal cover N/A
16-Jul (2.5 cfs, recorded at Bradbury Dam: no data for Santa Ynez or Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0530-0535	1658-1700	0530-0535	1658-1700
2	*	23.1	*	6.6
3	18.4	*	0.8	*

Table 3-9. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1996 (continued).

Site 3, Alisal Road, River Mile 7.8, algal cover N/A
16-Jul (2.5 cfs, recorded at Bradbury Dam: no data for Santa Ynez or Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0544-0549	1644-1646	0544-0549	1644-1646
3	19.6	20.0	0.2	0.2

Site 3A, Alisal Road, River Mile 8.7, algal cover N/A
16-Jul (2.5 cfs, recorded at Bradbury Dam: no data for Santa Ynez or Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0622-0629	1617-1619	0622-0629	1617-1619
3	*	20.6	*	9.4
3.5	21.9	*	4.4	*

Site 4A, River Mile 13.9, algal cover N/A
16-Jul (2.5 cfs, recorded at Bradbury Dam: no data for Santa Ynez or Solvang)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0710-0715	1541-1545	0710-0715	1541-1545
1	18.8	26.3	0.4	13.8

Site 5, Cargasachi Ranch, River Mile 24, 85% algal cover
16-Jul (0.5 cfs, recorded at Lompoc)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0700	1530	0700	1530
0-1	18.1	27.0	8.0	11.0

Table 3-9. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1996 (continued).

August, 1996

Site 2, Refugio X Site, River Mile 3.4, 0% algal cover
2-Aug (N/A)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0636-0641	1601-1606	0636-0641	1601-1606
0	16.8	23.3	9.31	10.43
1	16.8	23.3	9.23	10.34
2	16.8	23.3	9.2	10.29
3	16.8	23.2	9.19	10.29
4	16.8	23.2	9.12	10.36

Site 3, Alisal Road, River Mile 7.8, 0% algal cover
2-Aug (N/A)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0606-0614	1825-1830	0606-0614	1825-1830
0	18	25.5	8.58	10.08
1	18.1	25.5	8.48	10.07
2	18.1	25.5	8.48	10.09
3	18.1	25.5	8.54	10.1
4	18.1	25.5	8.46	10.06
5	18.1	25.5	8.52	10.1

Site 4A, River Mile 13.9, 0% algal cover
2-Aug (N/A)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0717-0723	1714-1719	0717-0723	1714-1719
0	19.3	26.3	7.53	13.29
1	19.3	26.3	7.51	13.16
2	19.3	26.3	7.55	13.12
3	19.3	26.3	7.52	13.11
4	19.3	26.3	7.45	13.09

Table 3-9. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1996 (continued).

Site 5, Cargasachi Ranch, River Mile 24, 0% algal cover
2-Aug (19 cfs, recorded at Lompoc)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	752-800	1559-1603	752-800	1559-1603
0	19.8	26.8	8.45	10.72
1	19.8	26.8	8.31	10.59
2	19.8	2678	8.28	10.59
2.5	19.8	26.7	8.26	10.59

Site 2, Refugio X Site, River Mile 3.4, 0% algal cover
17-Aug (N/A)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	540	1500-1505	540	1500-1505
0	18.6	24.5	9.2	10.2
1	18.6	24.5	8.9	10.1
2	18.6	24.4	8.9	9.9
3	18.5	24.3	9	9.7
4	18.5	24.3	9	9.4

Site 3, Alisal Road, River Mile 7.8, 0% algal cover
17-Aug (N/A)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0621-0626	1600-1605	0621-0626	1600-1605
0	19.3	26.5	8.3	9
1	19.3	26	8.3	9.5
2	19.3	26	8.2	9.2
3	19.3	26	8.1	9.4
4	19.2	26	8.1	9.4

Table 3-9. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1996 (continued).

Site 4, Alisal Road, River Mile 7.9, 0% algal cover
17-Aug (N/A)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0652-0657	1614-1620	0652-0657	1614-1620
0	19.5	25.9	9	8.8
1	19.5	25.9	9	8.8
2	19.5	25.9	9	8.8
3	19.5	25.9	9	8.8
4	19.5	25.9	9	8.8
5	19.5	25.9	8.9	8.2
6	19.5	25.9	8.9	8.2

Site 5, Cargasachi Ranch, River Mile 24, 0% algal cover
17-Aug (25 cfs, recorded at Lompoc)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	745	1230	745	1230

Unit not working

Table 3-9. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1996 (continued).

September, 1996

Site 2, Refugio X Site, River Mile 3.4, 0% algal cover
17-Sep (N/A)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0655-0700	1420	0655-0700	1420
0	15.5	21.8	8.3	13.5
1	15.5	21.8	8.2	13
2	15.5	21.8	8.2	13
3	15.5	21.8	8.1	13
4	15.5	21.8	8.1	13

Site 3, Alisal Road, River Mile 7.8, 0% algal cover
17-Sep (N/A)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0750-0755	1520-1525	0750-0755	1520-1525
0	16.6	22.6	7.5	11.8
1	16.6	22.5	7.4	11.8
2	16.7	22.5	7.4	11.8
3	16.7	22.5	7.4	11.8
4	16.7	22.5	7.4	11.8
5	16.7	22.5	7.4	12

Site 4A, River Mile 13.9, 0% algal cover
17-Sep (N/A)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0835-0840	1620-1625	0835-0840	1620-1625
0	17.8	22.6	7.5	11.2
1	17.9	22.6	7.4	11.2
2	17.9	22.6	7.3	11.2
3	17.9	22.6	7.3	11.2

Table 3-9. Results of diel temperature and dissolved oxygen measurements at various locations within the mainstem Santa Ynez River, 1996 (concluded).

Site 4, Alisal Road, River Mile 7.9, 0% algal cover
17-Sep (N/A)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	0800-0805	1530-1535	0800-0805	1530-1535
0	16.6	22.6	7.9	11.6
1	16.6	22.6	7.8	11.4
2	16.7	22.6	7.8	11.4
3	16.7	22.6	7.8	11.4
4	16.7	22.6	7.8	11.4

Site 5, Cargasachi Ranch, River Mile 24, 0% algal cover
17-Sep (17 cfs, recorded at Lompoc)

	Temperature (C)		Dissolved Oxygen (ppm)	
	Morning	Evening	Morning	Evening
Depth (ft)	905	1650	905	1650
1	17.8	22.8	9.4	10.4

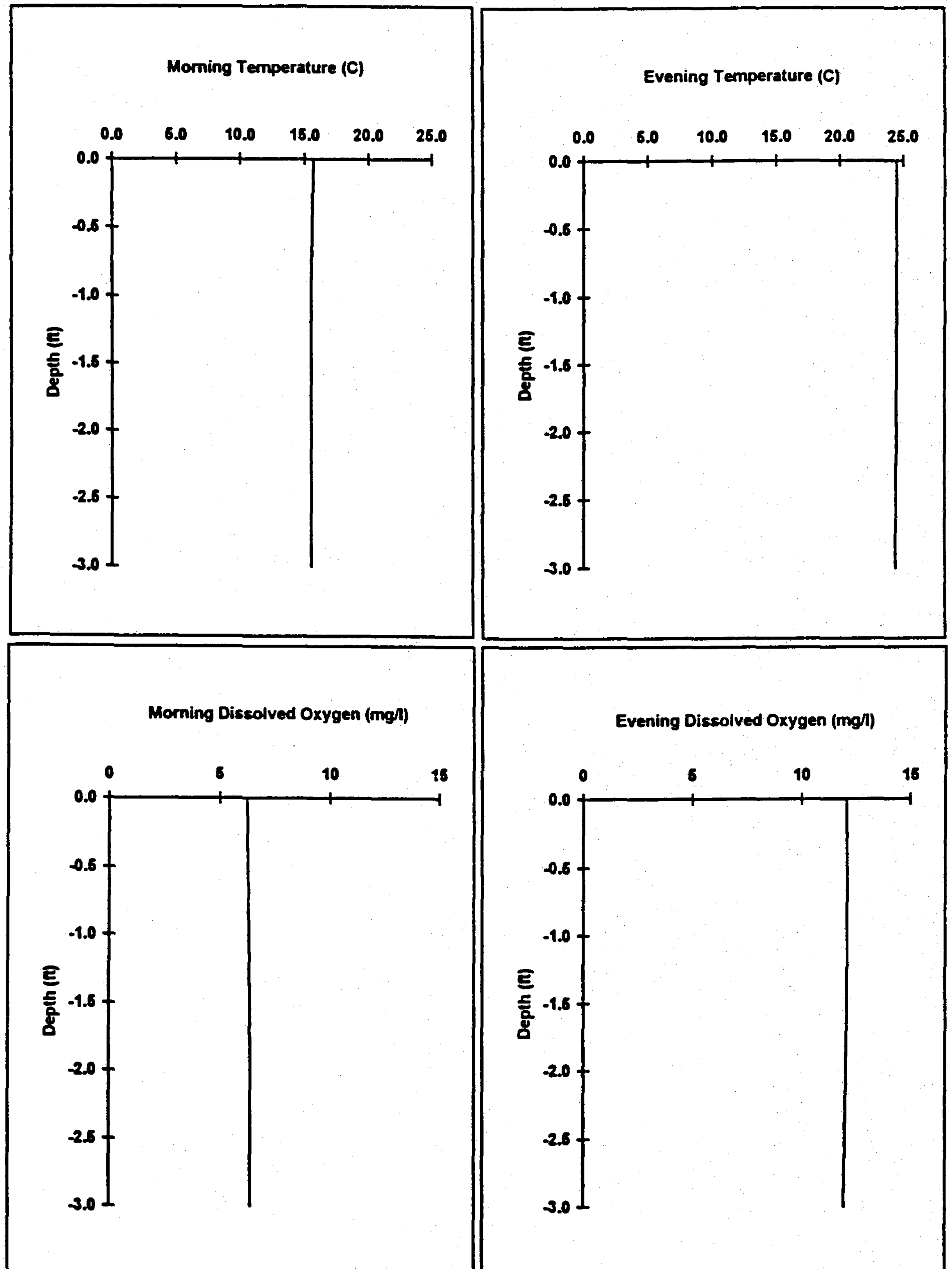


Figure 3-43. Vertical profiles in water temperature and dissolved oxygen concentrations measured during morning and evening hours at Alisal Road (mile 7.8) on April 15, 1996.

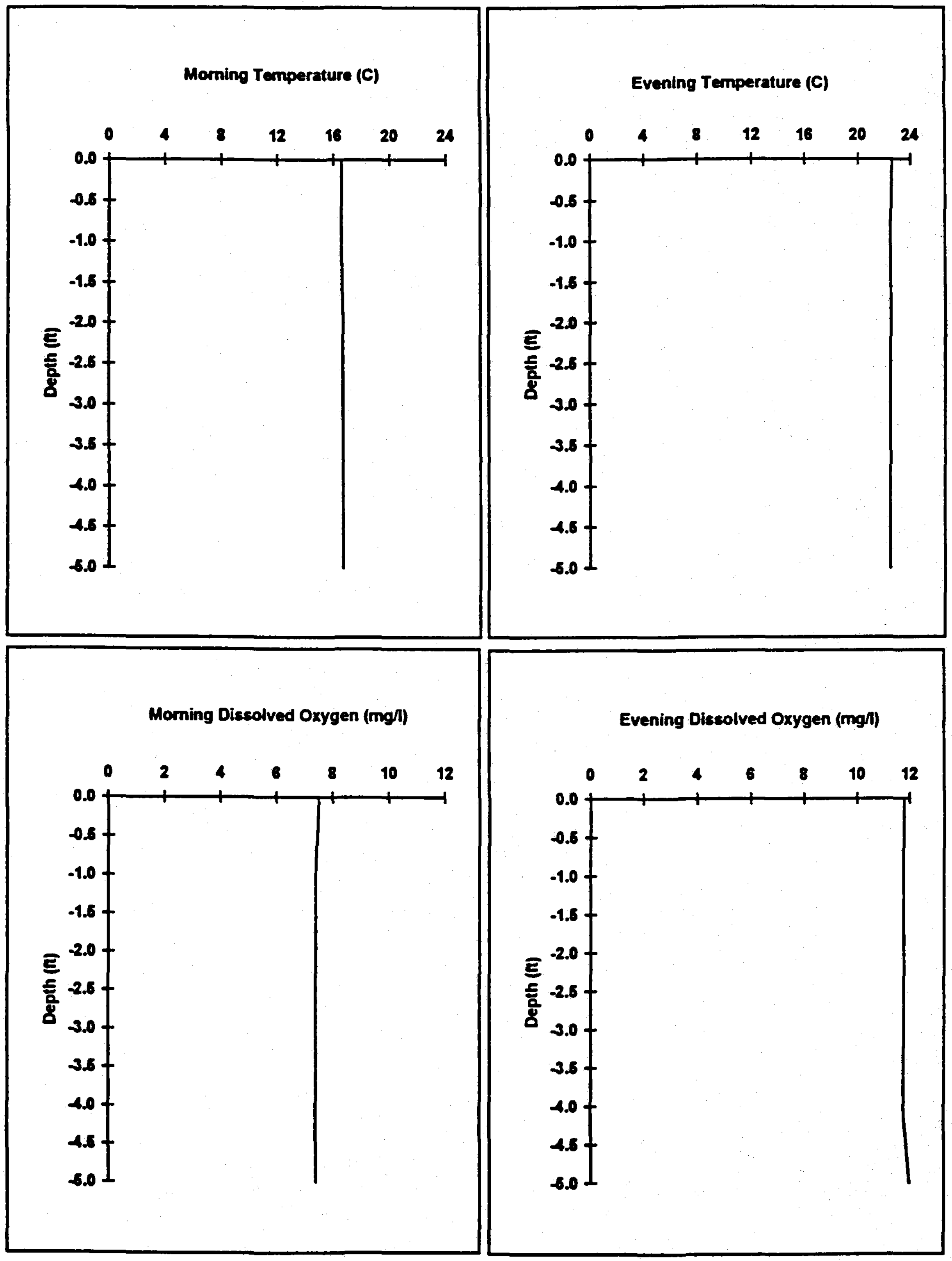


Figure 3-44. Vertical profiles in water temperature and dissolved oxygen concentrations measured during morning and evening hours at Alisal Road (mile 7.8) on September 17, 1996.

3.4 Santa Ynez River Lagoon Temperature, Dissolved Oxygen, and Salinity

The Santa Ynez River Lagoon represents a unique habitat characterized by saltwater/freshwater mixing. Water quality within the lagoon, particularly salinity, has a major influence on the species of fish and macroinvertebrates inhabiting this area of the system. To investigate water quality conditions within the lagoon, periodic surveys have been performed since 1993 to document salinity, temperature, and dissolved oxygen concentrations.

Water quality surveys were conducted within the lagoon sporadically during 1993 and 1994, with surveys conducted in August, 1993, March, 1994, and July, 1994. During these surveys, water temperature, salinity, and dissolved oxygen concentrations were measured at water depths of approximately 1 m (3.3 ft) intervals. During the August, 1993 and July, 1994 surveys freshwater inflow at the Narrows was less than 1 cfs, and the lagoon breach was closed. During the March, 1994 survey, inflow at the Narrows was 60 cfs, and the lagoon breach was open.

Water quality was monitored monthly at three locations within the lagoon beginning in August and continuing through December 1995 and January through July 1996. Site 1 was located directly across from Ocean Park. Site 2 was located at the approximate midpoint of the lagoon near the washed out bridge at 35th Street. Site 3 was located approximately 200 yards downstream from the river entrance when the lagoon was in a breached state. The monitoring crew used an inflatable raft to reach each Site. The crew entered the lagoon at the Ocean Park parking area and proceeded upstream. At each Site, a visual transect was established across the lagoon channel and measurements were taken at the approximate center, right one-third, and left one-third of the transect. Measurements were made throughout the water column at one foot intervals. Water quality was measured using a HYDROLAB DATASONDE 3 Water Quality Meter. The following water quality parameters were measured: temperature (C), dissolved oxygen, specific conductance, pH, salinity, and redox potential.

The above average rainfall year of 1995, and the large volume of water released from Bradbury Dam as spill, resulted in higher than average runoff in the river (Section 2). The high runoff caused the lagoon breach to open in January, before closing in late August or early September. The lagoon did not re-open again until January 29, 1996.

In general, no substantial differences were observed in water quality measurements across transects from August through December 1995. However, when the lagoon was both open and closed, water quality differences were noted between the upstream and downstream monitoring locations. Overall, the lagoon depth more than doubled at all sample locations after the lagoon closed. The following discussion centers around measurements made in the deepest portion of the channel.

Temperature

Water temperature was measured at six survey locations within the lagoon on August 30, 1993 (Table 3-10). Water temperature during the survey ranged from 20 to 25 C, with the majority of measurements ranging from 21-22 C.

Lagoon water quality monitoring in 1994 was conducted twice at the end of March and once in the middle of July. Water temperature from the surface to a depth of five feet was between 15-20 C in March (Table 3-11). Below five feet, temperature was between 13-14.1 C. In July, water temperatures had increased approximately 3 C from the surface to five feet (18.5-23 C). Below five feet, temperatures had increased to between 15-19.5 C from the March surveys (Table 3-11). Evidence of vertical stratification in water temperatures was apparent at deeper locations within the lagoon during both the March and July 1994 surveys.

Water quality in 1995 was measured in August, September, October, and December at three locations throughout the lagoon (Table 3-12). Slight vertical stratification in water temperature was observed at all three Sites during September. At Site 1 temperatures did not exceed 18.4 C, and were only slightly cooler compared to Sites 2 and 3 during any given month. Water temperatures at Site 3 were greater than those observed at Sites 1 and 2. Cooler water temperatures at Site 1 are likely to reflect ocean influence, while warmer temperatures at Site 3 are likely to reflect the effect of inflow from the Santa Ynez River. Water temperature was seldom greater than 20 C at any Site. Water temperatures exceeded 20 C at Site 2 in August (21.5 C) and at Site 3 in August and September (20.4-22.2 C).

Water quality in 1996 was measured in January, February, March, April, June, and July (Table 3-13) at the same locations used in the 1995 surveys (surveys have also been performed in August, September, and October, 1996, but have not been included in this report). No consistent evidence of vertical stratification in water temperatures was observed at Site 1 during any month. Site 1 (Ocean Park) had consistently lower water temperatures compared to Sites 2 and 3. Water temperatures at Site 1 were never greater than 20.5 C with the majority ranging between 18-19 C (Table 3-13). Water temperatures at Site 2 were slightly warmer than at Site 1 during the 1996 surveys (Table 3-13). Water temperatures were never greater than 22.15 C (surface measurement in April). By June and July, temperature was between 20-21.6 C from the surface to the bottom, with no apparent vertical stratification. Water temperature at Site 3 was consistently warmer than at Sites 1 and 2. Temperature remained greater than 20 C beginning in March. Surface measurements in April were 23.1 C. There was no consistent evidence of vertical stratification in water temperatures during any of the 1996 surveys at Site 3.

Dissolved Oxygen

Dissolved oxygen concentrations were measured within the lagoon in 1994 during one sampling period at the end of March and extensively in mid July. Dissolved oxygen concentrations measured in the limited March survey were not below 8 mg/L, with the exception of deeper water areas (9.8-16.4 ft) at Station 7, where dissolved oxygen ranged

Table 3-10. Water quality measurements within the Santa Ynez River Lagoon, 1993.

Station	Time (PDT)	Depth (ft)	Salinity (‰)	Temperature (°C)
1	c. 1200	0.0	2.0	21.5
		3.3	6.5	23.0
2		0.0	8.0	25.0
		4.1	13.0	22.0
3		0.0	12.0	22.0
		3.3	12.0	22.0
		6.6	12.5	21.5
4		0.0	13.0	22.0
		3.3	13.5	22.0
		6.6	16.0	21.0
5		0.0	14.0	22.0
		3.3	16.0	21.0
		6.6	17.0	20.0
6	c. 1600	0.0	14.0	22.0
		3.3	14.0	22.0

Breach Closed

Table 3-11. **Water quality measurements within the Santa Ynez River Lagoon, March 29, 1994. (Source: Entrix, 1995)**

Station	Time (PST)	Depth (ft)	Salinity (°/oo)	Temperature (°C)	Salinity Break[1]	D.O.
1	1410	0.0	1.0	20.0	0.0	N/S[2]
		1.6	1.0	20.0		
2	1430	0.0	1.5	20.5	0.0	N/S
		1.6	1.5	20.5		
3	1455	0.0	2.0	21.0	0.4'	N/S
		3.3	22.0	18.0		
4	1515	0.0	2.0	20.0	0.3'	N/S
		2.5	3.0	20.0		
5	1540	0.0	5.0	20.0	N/S	N/S
		1.6	9.0	20.0		
		3.3	24.0	17.0		
6	1605	0.0	12.0	20.0	2.5'	N/S
		3.3	25.5	16.0		
		4.9	26.0	16.0		
7	1625	0.0	23.0	18.0	0.0	N/S
		3.3	27.0	15.0		
		6.6	27.0	14.0		
		9.8	31.0	13.0		
		13.1	31.0	13.0		
		16.4	31.0	13.0		
8	1635	0.3	31.0	16.0	0.0	N/S

Breach Open   Low Tide 1655 0.8 ft.

[1]The salinity break represents the boundary between the relatively saline layer of water on the bottom and the relatively freshwater layer on top. The break is measured in feet above the bottom of the lagoon.

[2]Not sampled.

Stations 1-6 were located near the train trestle crossing within the lower lagoon.

Stations 7 and 8 were located in the mid-reach of the lagoon.

Table 3-11. **Water quality measurements within the Santa Ynez River Lagoon, March 31, 1994 (continued). (Source: Entrix, 1995)**

Station	Time (PST)	Depth (ft)	Salinity (°/oo)	Temperature (°C)	Salinity Break[1]	D.O.
1	1320	0.0	1.0	21.0	N/S	8.1
		1.6	1.9	21.0		8.1
2	N/S					
3	1300	0.0	1.2	20.5	N/S	10.0
		2.3	1.5	20.3		11.0
4	1245	0.0	2.1	20.3	N/S	8.0
		1.6	2.2	19.5		N/S
5	1225	0.0	4.0	19.7	N/S	11.2
		3.3	17.5	18.0		11.6
		3.9	21.5	18.0		N/S
6	N/S					
7	1150	0.0	22.0	17.0	N/S	N/S
		3.3	26.0	15.9		
		6.6	28.8	14.1		
		9.8	29.3	14.1		
		13.1	29.6	14.0		
		16.4	29.8	14.0		
8	1135	0.0	23.0	16.0	N/S	N/S

Breach Open

High Tide 1339 3.3 ft.

[1]The salinity break represents the boundary between the relatively saline layer of water on the bottom and the relatively freshwater layer on top. The break is measured in feet above the bottom of the lagoon.

[2]Not sampled.

Stations 1-6 were located near the train trestle crossing within the lower lagoon.

Stations 7 and 8 were located in the mid-reach of the lagoon.

Table 3-11. Water quality measurements within the Santa Ynez River Lagoon, March 31, 1994 (continued). (Source: Entrix, 1995)

Station	Time (PST)	Depth (ft)	Salinity (‰)	Temperature (°C)	Salinity Break[1]	D.O.
1	1350	0.0	1.0	21.5	0.0	N/S
		1.6	1.0	21.7		
2	1405	0.0	1.1	21.1	0.0	N/S
		3.3	1.1	21.5		
3	1430	0.0	1.2	20.9	0.0	N/S
		3.3	1.2	21.0		
4	1440	0.0	1.8	20.0	0.0	N/S
		1.6	1.9	20.0		
5	1455	0.0	4.3	20.0	1.3'	N/S
		3.3	4.5	20.0		
		4.9	26.5	17.0		
6	1530	0.0	4.8	19.5	2.3'	N/S
		3.3	18.0	17.5		
		4.6	18.2	16.5		
7	1550	0.0	5.6	19.2	N/S	N/S
		3.3	17.2	17.8		
		6.6	18.0	14.0		
		9.8	20.8	13.5		
		13.1	21.0	13.2		
		16.4	31.0	13.1		
		19.3	31.0	13.1		
8	1635	1.0	12.5	20.0	0.0	N/S

Breach Open High Tide 1339 3.3 ft.

[1]The salinity break represents the boundary between the relatively saline layer of water on the bottom and the relatively freshwater layer on top. The break is measured in feet above the bottom of the lagoon.

[2]Not sampled.

Stations 1-6 were located near the train trestle crossing within the lower lagoon.

Stations 7 and 8 were located in the mid-reach of the lagoon.

Table 3-11. Water quality measurements within the Santa Ynez River Lagoon, March 31, 1994 (continued). (Source: Entrix, 1995)

Station	Time (PST)	Depth (ft)	Salinity (°/oo)	Temperature (°C)	Salinity Break[1]	D.O.
4	1755	0.0	1.8	19.0	N/S	N/S
		1.6	1.9	19.5		
5	1735	0.0	3.0	18.7	N/S	8.8
		3.3	25.2	18.0		
6	1720	0.0	6.0	19.0	N/S	N/S
		3.3	28.3	17.5		
7	1700	0.0	6.2	19.1	N/S	10.8
		3.3	28.3	16.0		13.1
		6.6	28.9	14.0		9.9
		9.8	28.9	13.5		6.9
		13.1	31.3	13.5		4.7
		16.4	31.5	13.1		4.7

[1]The salinity break represents the boundary between the relatively saline layer of water on the bottom and the relatively freshwater layer on top. The break is measured in feet above the bottom of the lagoon.

[2]Not sampled.

Stations 1-6 were located near the train trestle crossing within the lower lagoon.

Stations 7 and 8 were located in the mid-reach of the lagoon.

Table 3-11. **Water quality measurements within the Santa Ynez River Lagoon, July 12, 1994 (continued). (Source: Entrix, 1995)**

Station	Time (PDT)	Depth (ft)	Salinity (°/oo)	Temperature (°C)	D.O. (ppm)
7	0945	0.0	14.0	19.0	4.8
		3.3	14.0	19.0	3.4
		6.6	14.0	18.5	0.4
		9.8	31.0	17.0	0.0
		13.1	31.0	15.0	0.0
1	1350	0.0	2.2	21.0	12.4
		1.6	7.0	21.0	4.2
		3.3	14.0	23.0	0.8
2	1410	0.0	2.0	19.5	12.0
		1.6	6.5	21.5	10.8
		3.0	12.5	23.0	7.2
		5.6	15.0	22.0	1.6
3	1425	0.0	6.0	21.0	12.6
		1.6	9.0	22.0	10.0
		3.3	14.5	22.5	4.0
		4.9	14.5	21.5	1.0
		5.9	14.5	21.0	0.4
4	1435	0.0	11.0	21.5	12.1
		1.6	11.0	22.0	11.6
		3.3	12.0	22.0	8.6
		4.3	14.0	21.5	1.6
5	1445	0.0	12.5	21.0	11.0
		1.6	13.0	21.5	8.2
		3.3	14.0	21.1	4.8
		4.9	14.0	21.0	3.2
		6.6	14.2	20.3	1.2
		7.2	14.2	20.3	0.1
6	1500	0.0	14.0	20.0	7.2
		1.6	14.0	20.0	7.0
		3.3	14.0	20.0	6.7
		4.9	14.0	20.0	6.6
		6.6	14.5	20.0	3.6

Table 3-11. Water quality measurements within the Santa Ynez River Lagoon, July 12, 1994 (concluded). (Source: Entrix, 1995)

Station	Time (PDT)	Depth (ft)	Salinity (°/₀₀)	Temperature (°C)	D.O. (ppm)
7	1515	0.0	14.0	19.5	6.4
		3.3	14.0	19.5	4.8
		6.6	14.0	19.5	2.3
		9.8	31.0	17.0	0.2
		13.1	31.0	15.0	0.0
8	1525	0.0	14.2	20.0	7.4
		1.6	14.5	20.0	7.2

Breach Closed

Stations 1-6 were located near the train trestle crossing within the lower lagoon.

Station 7 and 8 were located in the mid-reach of the lagoon.

Table 3-12. Water quality measurements within the Santa Ynez River Lagoon, 1995.

Site 1, Ocean Park
25-Aug-95 at 1119 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	16.37	7.77	33.8
1	16.34	7.39	34.2
2	16.26	7.32	34.9
3	16.15	7.65	35.7

Site 2, Mid-Lagoon
25-Aug-95 at 1355 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	21.5	11.47	7.4
1	21.51	11.13	8.6

Site 3, Upper Lagoon
25-Aug-95 at 1342 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	22.16	16.18	1.6
1	22.21	16.53	1.6

Site 1, Ocean Park
27-Sep-95 at 1200 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	18.42	12.21	25.5
1	17.84	11.94	25.6
2	15.29	10.11	32.2
3	15.11	9.37	34
4	15.48	9.16	34.6

Site 2, Mid-Lagoon
27-Sep-96 at 1200 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	18.74	16.84	24.2
1	18.78	17.14	24.4
2	18.2	14	25.6
3	16.67	6.8	32.5

Site 3, Upper Lagoon
27-Sep-951245 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	20.48	18.96	24.1
1	20.35	19.61	24.2
2	19.7	16.59	25.4

Table 3-12. Water quality measurements within the Santa Ynez River Lagoon, 1995 (concluded).

Site 1, Ocean Park
31-Oct-95 at 1125 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	17.91	17.79	13.3
1	17.82	17.16	13.5
2	17.16	15.42	14.2
3	16.97	13.77	14.6
4	16.85	12.7	15.3
5	17.1	8.76	16.9
6	17.23	0.94	18.4
6.5	17.34	0.49	21.2

Site 2, Mid-Lagoon
31-Oct-95 at 1223 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	18.67	>20	7
1	18.56	18.68	9.9
2	18.41	14.27	13.9
3	17.89	14.13	14.7
4	17.64	8.39	15.6
5	17.49	1.94	16.9
6	17.5	0.78	18

Site 3, Upper Lagoon
31-Oct-95 at 1317 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	19.14	>20	4.5
1	19.06	10.22	7.5
2	18.73	11.11	14.1
3	18.3	10.79	14.6
4	17.97	1.77	15.6
5	18.02	0.69	16.7

Site 1, Ocean Park
5-Dec-95 at 1058 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	14.41	9.26	15.4
1	14.43	9.3	15.4
2	14.53	9.27	15.5
3	14.53	9.27	15.8
4	14.63	7.15	17.4
5	15.65	4.3	23
6	16.01	3.36	24.2
7	15.96	2.94	24.4

Site 2, Mid-Lagoon
5-Dec-95 at 1250 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	15.82	9.06	13.6
1	15.9	9.07	13.5
2	15.08	9.48	14.4
3	14.9	9.57	14.7
4	14.84	9.57	14.7
5	14.82	9.5	14.9
6	14.92	9.07	15.3

Site 3, Upper Lagoon
5-Dec-95 at 1340 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	16.39	8.69	13.3
1	16.43	8.78	13.4
2	16.42	8.78	13.5
3	16.36	8.96	13.7
4	16.19	8.97	14
5	16.13	8.56	14.3

Table 3-13. Water quality measurements within the Santa Ynez River Lagoon, 1996.

Site 1, Ocean Park
10-Jan-96 at 1150 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	13.49	9.09	11.6
1	13.52	9.11	11.6
2	13.2	9.08	11.6
3	12.86	8.92	11.8
4	12.02	9.33	12.2
5	11.96	9.13	12.3
6	11.98	8.61	12.3
7	12.03	7.41	12.4
8	12.7	3.79	14.1
9	12.95	3.09	14.9
10	13.05	3.26	15.1

Site 2, Mid-Lagoon
10-Jan-96 at 1314 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	14.84	11.88	10.1
1	14.44	11.55	10.4
2	13.29	9.62	11.7
3	12.95	9.08	12.5
4	12.9	8.26	13
5	12.8	7	13.5
6	12.92	5.31	13.9
7	12.96	4.52	14.1
8	13.36	3.24	14.7
9	13.58	2.55	15.1
10	13.67	2.12	15.3

Site 3, Upper Lagoon
10-Jan-96 at 1314 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	15.99	12.1	10.3
1	15.96	12.36	10.3
2	15.5	12.44	10.6
3	14.36	11.84	12.3
4	13.38	10.46	13.1
5	13.18	8.64	13.6
6	13.27	6.69	13.8
7	13.64	5.34	14.3
8	14.02	2.71	14.8

Site 1, Ocean Park
6-Feb-96 at 1032 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	15.99	6.77	9.9
1	14.69	6.93	21.2
2	14.65	7.01	23.6
3	13.59	7.2	32
4	13.59	7.44	33.3
5	13.51	7.5	34.3
6	13.5	7.56	34.3

Site 2, Mid-Lagoon
6-Feb-96 at 1201 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	17.05	6.93	2.8
1	17.04	6.9	2.5
2	16.26	6.56	5.2
3	15.4	6.18	8.3
4	14.89	5.58	21.3
5	14.57	5.2	25.8
6	14.53	5.14	26.2

Site 3, Upper Lagoon
6-Feb-96 at 1311 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	17.75	7.45	0.9
1	17.72	7.47	0.9
2	17.5	7.5	0.9
3	17.43	7.51	0.9
4	17.45	7.51	0.9

Table 3-13. Water quality measurements within the Santa Ynez River Lagoon, 1996 (continued).

Site 1, Ocean Park
11-Mar-96 at 1206 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	18.97	7.88	2.2
1	18.63	12.1	2.4
2	18.82	13.18	22.6
3	16.39	9.09	27.7

Site 2, Mid-Lagoon
11-Mar-96 at 1357 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	18.81	9.83	1.2
1	18.81	9.86	1.2
2	18.83	10.6	1.2
3	19.33	14.71	21.5
4	18.61	13.41	25.4
4.5	18.49	13.5	26.2

Site 3, Upper Lagoon
11-Mar-96 at 1425 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	21.44	9.73	1
1	21.46	9.95	1
2	21.47	10.22	1

Site 1, Ocean Park
29-Apr-96 at 1050 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	18.96	10.8	8.1
1	18.68	11.02	8.1
2	18.44	11.27	8.2
3	18.22	11.14	8.2
4	17.54	9.63	8.5
5	18.13	3.69	21.6

Site 2, Mid-Lagoon
29-Apr-96 at 1238 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	22.15	13.83	5.3
1	22.01	13.58	5.4
2	19.8	14	9.3
3	19.95	12.12	13.5
4	19.93	10.51	15
5	19.95	8.01	16.2
6	19.52	2.3	20

Site 3, Upper Lagoon
29-Apr-96 at 1356 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	23.14	15.06	6.8
1	23.14	15.52	6.8
2	23.08	16.83	7.8
3	22.16	17.13	12.4
4	21.49	12.01	13.7

Table 3-13. Water quality measurements within the Santa Ynez River Lagoon, 1996 (concluded).

Site 1, Ocean Park
4-Jun-96 at 1240 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	19.32	20	10.6
1	19.48	16.91	12.3
2	19.31	13.76	14.1
3	19.88	8.68	15.6
4	20.51	3.65	19.9
5	20.16	0.94	22

Site 2, Mid-Lagoon
4-Jun-96 at 1124 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	20.39	20	6
1	20.68	20	8.2
2	21.65	15.03	12.3
3	21.44	8.15	15.2
4	21.24	4.71	18.7
5	20.87	1.71	21
6	20.22	0.23	23

Site 3, Upper Lagoon
4-Jun-96 at 1232 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	21.9	20	5.4
1	22.13	20	6.3
2	22.71	11.9	10.7
3	22.45	4.7	13.1
4	21.14	1.72	18.2

Site 1, Ocean Park
9-Jul-96 at 1216 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	20.02	5.48	10.2
1	20.01	5.48	10.3
2	19.98	5.46	10.3
3	19.44	3.77	10.8
4	19.04	3.54	11.1
5	18.84	2.27	11.2
6	19.07	0.35	11.7
7	19.5	0.08	15.7

Site 2, Mid-Lagoon
9-Jul-96 at 1305 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	20.95	7.81	5.3
1	20.67	5.35	5.5
2	21.08	3.49	6.4
3	21.14	3.17	10.6
4	19.98	1.33	10.8
5	20.02	0.86	11.7
6	20.03	0.23	11.7
7	20.05	0.17	12.8
8	20.18	0.12	15.5

Site 3, Upper Lagoon
9-Jul-96 at 1401 hours
Status of lagoon breach N/A

Depth (ft)	Temp. (C)	DO (ppm)	Salinity (ppt)
0	21.49	7.71	3.3
1	21.56	7.62	4
2	21.52	5.59	4.2
3	22.18	3.09	9.3
4	21.41	1.21	9.9
5	21.35	0.89	11.6

from 4.7 to 6.9 mg/l (Table 3-11). In July, however, dissolved oxygen concentrations less than 5 mg/l were observed at several locations and water depths (Table 3-11). Near bottom dissolved oxygen concentrations were occasionally observed to be anoxic in the deeper portions of the lagoon (Table 3-11).

Moderate to high concentrations (7.3-18.9 mg/L) of dissolved oxygen were recorded throughout the water column at all three Sites in August and September, 1995 (Table 3-12). Site 3 recorded the highest dissolved oxygen levels for both months (16.2-19.8 mg/L). Dissolved oxygen stratification began to develop in September at all three sample locations. By October, water depth had more than doubled at Sites 2 and 3 and anoxic conditions had developed in the lower two feet of the water column at all three Sites (Table 3-12). In December, stratification was still established at Site 1, but dissolved oxygen levels had increased moderately to between 2.9-4.3 mg/L in the lower three feet. Sites 2 and 3 had nearly uniform dissolved oxygen concentrations between 8.6-9.6 mg/L throughout the water column.

During the 1996 surveys, water depth varied between 3-10 feet at Site 1 (Ocean Park), between 4.5-10 feet at Site 2 (mid lagoon), and between 2-8 feet at Site 3 (near Santa Ynez River inflow). January was the month with the greatest depth, and March had the least depth at all three sampling Sites. No pattern in dissolved oxygen concentrations was observed between the upper and lower portions of the lagoon during any given month. However, dissolved oxygen stratification developed at all three sample Sites in January, April, June, and July, and did not develop in February and March. Generally, dissolved oxygen concentrations were greater than 5 gm/L in the upper three-quarters of the water column during months when stratification developed. The lower one-quarter of the water column however, had levels less than 4 mg/L with anoxic levels developing at the bottom one foot at most Sites (Table 3-13).

Salinity

Salinity, the dissolved solids present in sea water, is reported in parts per thousand (ppt). Full-strength sea water has a salinity of about 33-35 ppt. Salinity decreases gradually from the sea to the upstream limit of the estuary, which is considered fresh water at about 0.5 ppt (Lind 1985). The presence of dissolved salts increases the density of water.

Based on results of salinity monitoring from 1993-1996, salinity levels in the lagoon follow a consistent longitudinal pattern with salinity near brackish/full strength sea water at Site 1, brackish water at Site 2, and brackish/freshwater at Site 3. Salinity levels varied significantly at each Site between months which may reflect seasonal variation in freshwater inflow and tidal influence. Higher salinity concentrations were observed at high tides at all three Sites, particularly when the lagoon was open.

While the lagoon was open in August 1995, salinity was essentially full strength sea water throughout the entire water column (33.8-35.7 ppt in 3 feet) at Site 1 (Table 3-12). Longitudinally, salinity decreased sharply at Sites 2 and 3. After the lagoon closed and water depth began to increase in September, the formation of the salt wedge was evident at Site 1 with measurements of 25.5-34.6 ppt from the surface to a depth of 4 feet. Sites 2

(24.2-32.5) and 3 (24.1-25.4 ppt) showed nearly identical salinity concentrations compared to Site 1 in September. From October through December, water depth increased several feet, and salinity decreased sharply at all sampling Sites. Salinity at Site 1 remained higher than that at Site 3 throughout the periods when the lagoon breach was open and closed.

In January 1996, salinity at all three sampling Sites varied between 10.3-15.3 ppt with slightly higher levels recorded at the bottom of Site 2. February measurements at Sites 1 and 2 had the greatest salinity concentrations of any month, ranging between 21.3-34.3 ppt in the bottom three feet. The greatest vertical variations in salinity within the water column were recorded at Sites 1 and 2 in March which had levels of 1.2-2.2 ppt at the surface and 26.2-27.7 ppt at the bottom. Salinity levels at Site 3 in February and March were approximately 1.0 ppt. Salinity concentrations never exceeded 18.2 ppt at Site 3, and were generally between 3.3-13.7 ppt in 1996. From April through July, vertical distributions are similar throughout the lagoon with slightly higher concentrations recorded at Site 1 (Table 3-13).

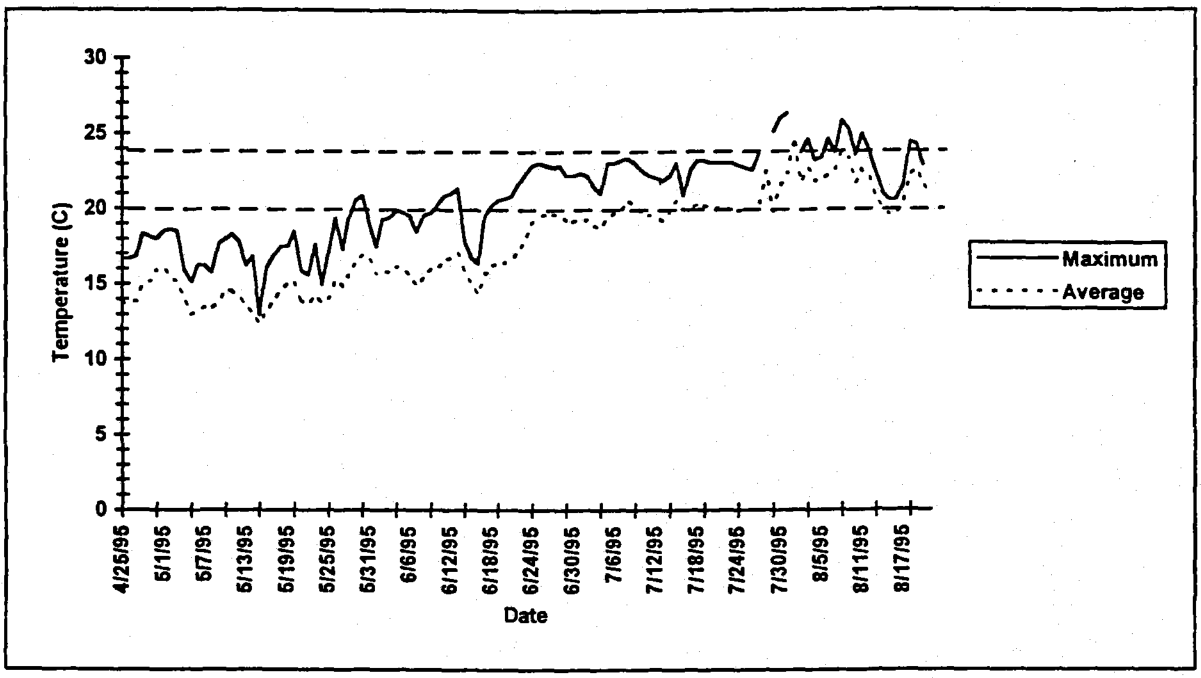
3.5 Tributaries: Water Temperature

Hilton Creek-250 ft. Upstream of Santa Ynez River Confluence

Water temperature was monitored within Hilton Creek at a location approximately 250 feet upstream from the confluence of the Santa Ynez River. The location of the temperature recorder is characterized as relatively shallow, channel, having little shading and riparian vegetation. Although this temperature monitoring location coincides with the location of fish trapping within Hilton Creek, it may not be representative of water temperature conditions further upstream where the stream channel is much more shaded by steep walls and more extensive riparian vegetation along both sides of the stream channel. Water temperature has shown a general seasonal pattern of increasing temperatures during the late spring and summer (Figure 3-45), as measured in 1995.

From June through August 20, 1995 temperatures during the hottest portion of the day varied between 16.4-26.3 C. Diel variation in water temperature typically ranged from 2.5 - 7 C during the spring-summer monitoring period. The highest temperatures recorded were 26.3 C (July) and 25.8 C (August). Young-of-the-year rainbow trout/steelhead were observed to be generally healthy and actively feeding at these elevated water temperatures. Young of the year rainbow trout/steelhead were observed to be actively feeding during a survey on August 8 at a water temperature of 25.8 C.

The average daily and maximum daily water temperatures recorded during the summer monitoring period in 1995 were evaluated. Water temperatures were evaluated based upon the frequency of temperatures equal to or exceeding a 20 C average daily temperature, or a 24 C maximum daily temperature. Based upon results of water temperature monitoring between late April and late August, 1995, average daily water temperatures were equal to or greater than 20 C within lower Hilton Creek on 13 days in July and 17, out of 19 days monitored, in August (see Table 3-5 for monthly frequency of exceedence). No days exceeding the criteria in May or June, nor during the last six days



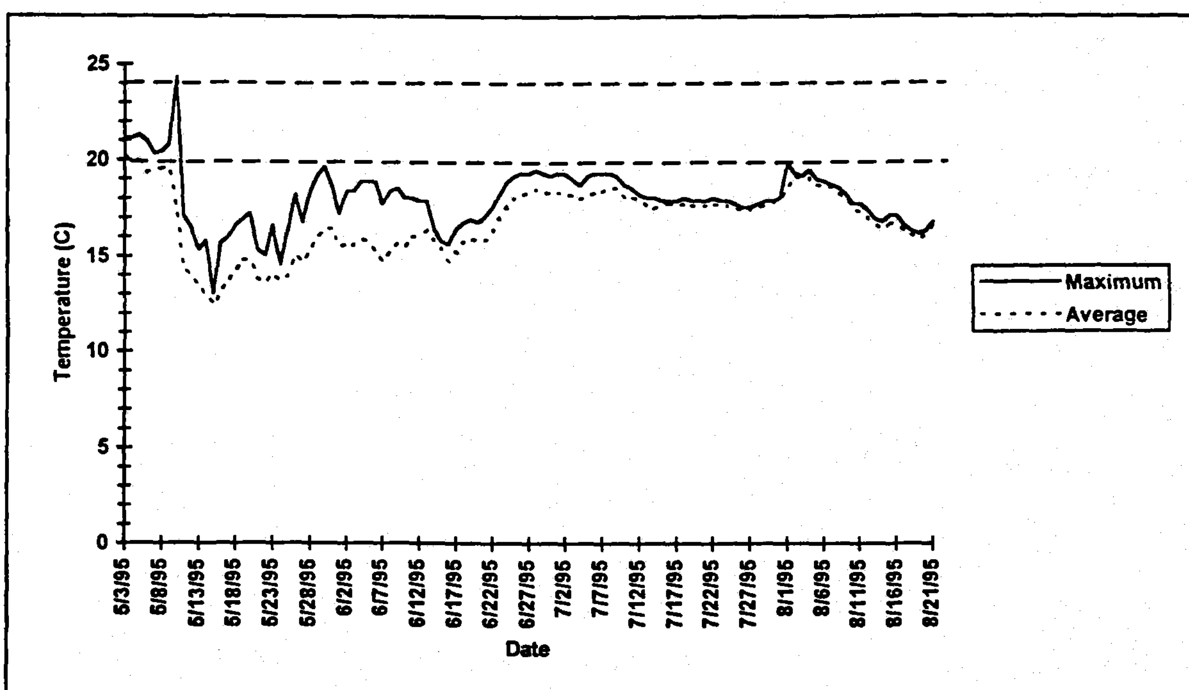


Figure 3-45. **Average daily and maximum water temperatures measured within Hilton Creek at the upstream migrant trapping location (Upper Panel)and upper Shute Pool (Lower Panel).**

of April. Maximum daily water temperatures were equal to or greater than 24 C on three days in July, and during 7 of the 19 days monitored in August, 1995. Water temperatures exceeded the incipient lethal threshold (25 C) in July (3 days), and August (3 days), 1995.

Flow through Hilton Creek decreased quickly at the end of April and beginning of May, 1995. During May, two storms produced a total of 1.78 inches of rain which temporarily increased flows. Observed flows decreased quickly in June. By July 5, 1995, continuity with the mainstem river was lost. By July 29 flows within Hilton Creek had decreased to the point that the temperature unit was exposed to air and the lower 250 feet of creek was dry.

A thermograph was not deployed in lower Hilton Creek in 1996 due to lack of water and limited fish use. Hilton Creek began to flow into the mainstem river on February 20, 1996. By February 26, flow was no longer contiguous with the Santa Ynez River and the lower 40 feet of creek was dry. Hilton Creek has not re-established surface flow with the mainstem river to date.

Hilton Creek-Upper Shute and Spawn Pool - 1995 and 1996

A deeper water pool exists within Hilton Creek, approximately 1,200 feet upstream of the confluence, immediately downstream of a potential upstream migrating fish passage barrier which represents an area where adult rainbow trout/steelhead may accumulate and/or juvenile rearing may occur. To investigate spring and summer water temperatures within this pool, a temperature recorder was installed during a limited period of the year in 1995 and again in 1996. During 1995 the recorder was in operation from May through late August, during which time water temperatures were observed to be substantially lower than those monitored further downstream within lower Hilton Creek. The daily average water temperature criterion (20 C) was exceeded on 2 days in May, 1995 and the maximum daily criterion (24 C) was exceeded on one day in May, 1995 (Table 3-5). Water temperatures monitored during the spring and early summer, 1995 are shown in Figure 3-40. Daily fluctuations in water temperature typically ranged from 1 to 5 C, with the magnitude of variation within the day becoming progressively less later in the summer. The reduction in diel fluctuations may reflect, in part, diminishing inflow from upper Hilton Creek into the pool. During 1995 the Shute Pool was the last refuge habitat to remain in Hilton Creek after the lower creek dried and lost surface flow continuity with the mainstem.

The Upper Shute Pool did not persist throughout either 1995 or 1996. The duration that the pool retained surface waters varied between the two years, with the pool persisting over a longer period in 1995, which was a wet year characterized by high rainfall within the watershed. In 1995 the pool did eventually dry to a point that surviving adult and juvenile rainbow trout/steelhead were rescued from the pool and relocated downstream to the Spilling Basin and Long Pool.

Table 3-14 presents a comparative summary of the monthly average and monthly maximum water temperatures observed at the Shute monitoring location during the period March through August, 1995 and 1996. Based upon the limited monitoring data collected at this location within Hilton Creek, it appears that water temperatures may be suitable through at least August to provide habitat for rainbow trout/steelhead. The adequacy of the available habitat would also depend upon freshwater inflow, water depth within the pool, availability of a forage base, and a recognition that this pool habitat would be isolated from fish movement either upstream or downstream during at least a portion of the year.

Table 3-14. Comparison between monthly average maximum and monthly average water temperatures (C) within upper Hilton Creek during 1995 and 1996.

	1995	1996	1995	1996
Month	Monthly Max	Monthly Max	Monthly Avg	Monthly Avg
March	N/A	14.79	N/A	12.45
April	N/A	14.40	N/A	13.92
May	17.90	14.25	15.75	13.87
June	17.99	19.18	16.29	16.03
July	18.32	N/A	17.89	N/A
August	17.81	N/A	17.49	N/A

Nojoqui Creek

Water temperatures have been measured within Nojoqui Creek at a location approximately two miles upstream of the confluence with the Santa Ynez River over the period from late April, 1995 through early August, 1996 (Figure 3-46). Water temperatures over this time period have shown a general seasonal pattern of increasing temperature during the spring and summer, with decreasing temperatures during the fall and winter. Variation between average daily and maximum daily water temperature was substantially greater, at least during two time periods in 1996 (Figure 3-46) when compared with the more consistent temperature pattern observed in 1995. Variation in the magnitude of diel variation and variability in temperatures between the two years is likely to reflect differences between instream flow within the creek during 1995 (high flows) and 1996. Variation in seasonal air temperature between the two years would also contribute to the observed variation in water temperatures at this Site.

Examination of the available temperature data for the upper unit showed that both the average daily and maximum daily water temperature exceeded the 20 and 24 C criteria during the summer of 1995 and 1996. Water temperatures exceeded the incipient lethal threshold (25 C) during June (5 days), July (5 days), and August (3 days), 1995 and June (5 days) of 1996 (Table 3-5).

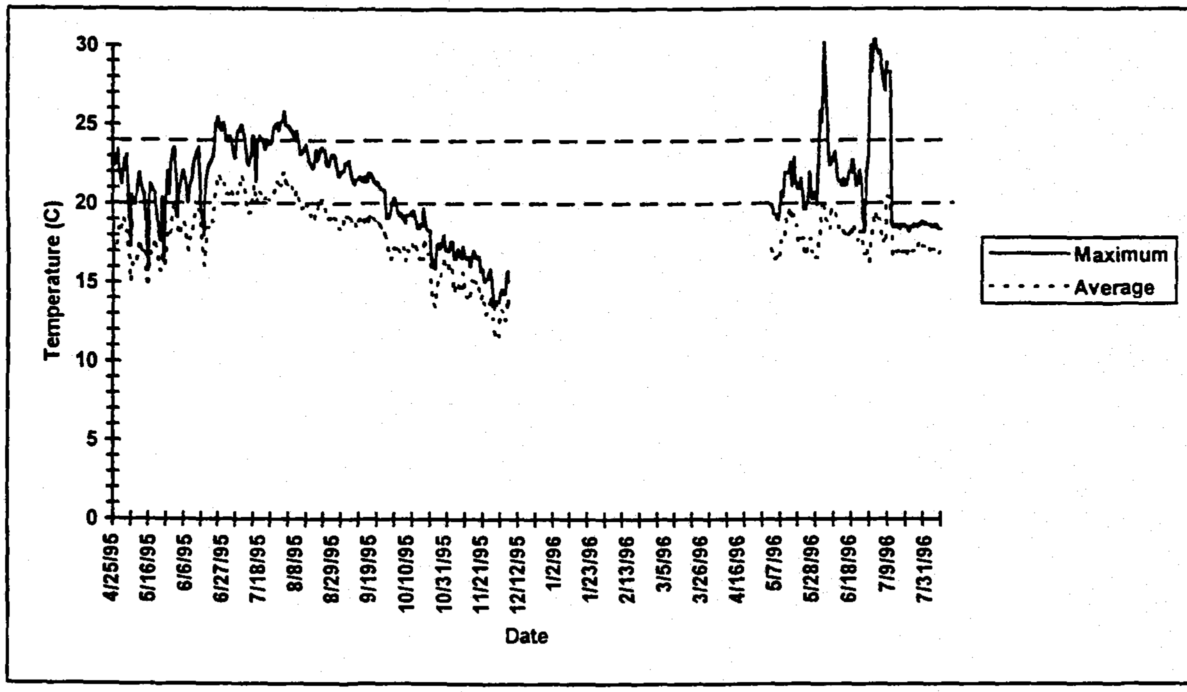


Figure 3-46. **Average daily and maximum water temperatures within upper Nojoqui Creek, located two miles upstream of the confluence with the Santa Ynez River.**

Salsipuedes Creek - 100 Feet Upstream of El Jaro Creek Confluence

Upper Salsipuedes is characterized by having an intact riparian corridor with abundant canopy (even after the 1995 storms). Salsipuedes Creek upstream of the confluence is significantly cooler than El Jaro and lower Salsipuedes Creeks. Water temperatures did

not exceed 25 C in either 1995 or 1996 (Figure 3-47). At no time did average daily temperatures exceed 20 C (Table 3-5). Temperatures greater than 20 C generally lasted between one and nine hours. Maximum daily temperatures did not exceed 24 C in monitoring between April and December, 1995 and May-June, 1996. Diel variation in water temperature ranged from 1 to 7 C, with the greatest variation during the summer and the lowest diel variation occurring during the winter.

In 1995, a noticeable warming trend in the average monthly temperatures (Table 3-15) was recorded in June (17.0 C), peaked in July (18.5 C), and began to decrease in August (18.2 C) and September (17.2 C). Data recorded in 1996 (May and June only) showed that both the monthly maximum and average temperatures were slightly greater in May 1996 compared to May 1995. However, in June, both the monthly maximum and average water temperatures were slightly greater in 1995 compared to 1996. Data collected in 1995 indicates the warming trend began abruptly around June 20 extending to around September 26, before gradually cooling to around 14 C in December.

Summer water temperatures were also monitored in Salsipuedes Creek downstream of Jalama Bridge in 1993. Temperature monitoring results (Figure 3-18) show maximum daily temperatures exceeding 25 C, with average daily summer temperatures occurring above 20 C.

Table 3-15. Comparison between monthly average maximum and monthly average water temperatures (C) within upper Salsipuedes Creek during 1995 and 1996.

Month	1995 Monthly Maximum	1996 Monthly Maximum	1995 Monthly Average	1996 Monthly Average
May	18.69	19.25	15.76	16.54
June	20.30	19.30	17.04	16.74
July	21.79	N/A	18.47	N/A
August	21.60	N/A	18.18	N/A
September	19.65	N/A	17.20	N/A
October	17.34	N/A	15.51	N/A
November	14.95	N/A	13.71	N/A

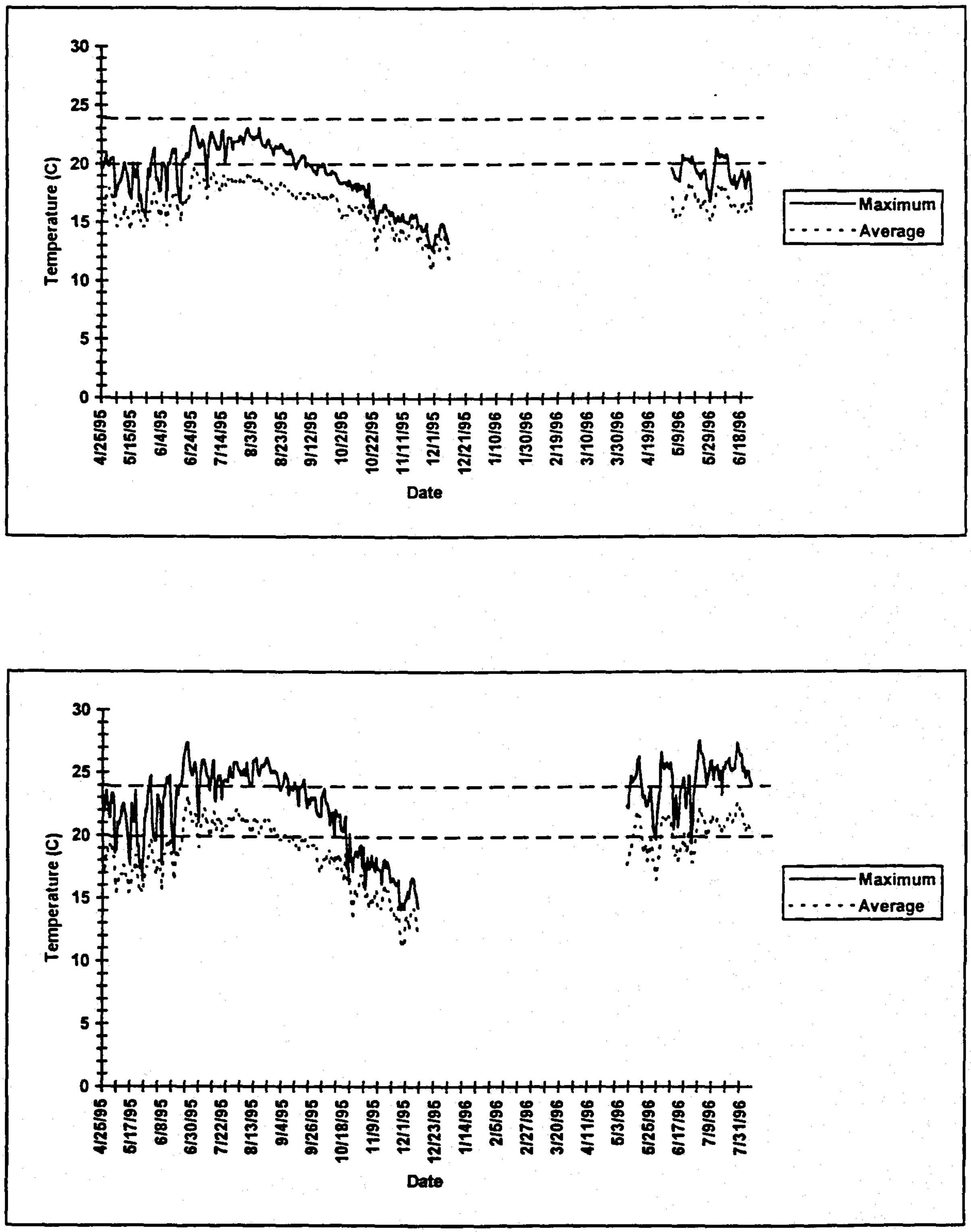


Figure 3-47. **Average daily and maximum water temperatures measured within Salsipuedes Creek, approximately 100 feet upstream of the confluence with El Jaro Creek (Upper Panel) and lower Salsipuedes Creek, approximately 2 miles downstream of the confluence with El Jaro Creek (Lower Panel).**

Salsipuedes Creek- 2 Miles Downstream of Confluence with El Jaro Creek

Water temperature has been monitored within Salsipuedes Creek at a location two miles downstream of El Jaro Creek beginning in late April, 1995, and continuing through early August, 1996. The resulting temperature data (Figure 3-47) show a general pattern of seasonal warming during the spring and summer, followed by a declining trend in water temperatures during fall and winter, similar to that observed at other locations, and reflecting, in part, the seasonal pattern in ambient air temperatures.

A comparison of water temperature monitoring results from Salsipuedes Creek upstream of the confluence with El Jaro Creek, and downstream of the confluence with El Jaro Creek (Figure 3-47), illustrates the contribution of elevated water temperatures within El Jaro Creek on the temperature and habitat conditions within lower Salsipuedes Creek. Water temperatures were substantially higher within Salsipuedes Creek downstream of the confluence with El Jaro Creek. The contribution of El Jaro Creek, particularly during the summer months, resulted in an increase in both average daily and maximum daily water temperatures occurring within Salsipuedes Creek (Figure 3-47). Examination of summer water temperature data within Salsipuedes Creek downstream of the confluence with El Jaro Creek shows that both the average daily and maximum daily temperatures exceeded the 20 C, 24 C, and 25 C temperature criteria in both 1995 and 1996 (Table 3-5). Maximum daily water temperatures also exceeded the 24 C criterion in May (2 days), June (15 days), July (26 days), August (31 days), and September (18 days). Average temperatures exceeded the 20 C criterion from June 22 through August 31, 1995. In 1996, the maximum daily threshold (24 C) was exceeded in May (10 days), June (20 days), July (30 days), and August (7 of 7 days). Average temperatures exceeded the 20 C criterion in May (8 days), June (17 days), July (31 days), and August (7 of 7 days). Maximum daily temperatures exceeded 27 C on occasion in both 1995 and 1996, representing conditions potentially above the incipient lethal level for rainbow trout/steelhead. Diel temperature fluctuations typically range from 1 to 8 C, with the greatest daily variation occurring during the summer, and the lowest variation typically occurring during the winter and spring.

Table 3-16 presents a comparative summary of average monthly water temperatures during the spring and summer period between 1995 and 1996. In general, average monthly temperatures were slightly greater in 1996 than those in 1995. Variation in instream flows may account, in part, for both the observed variation in absolute temperatures between the two years in addition to the observed variation within each year. The data available on seasonal flows within the creek during the summer of 1995 and 1996 (Table 2-4) is not, however, adequate to evaluate the effects of flow on inter-annual temperature differences.

Table 3-16. Comparison between monthly average maximum and monthly average water temperatures (C) within lower Salsipuedes Creek during 1995 and 1996.

Month	1995 Monthly Maximum	1996 Monthly Maximum	1995 Monthly Average	1996 Monthly Average
May	21.00	23.24	17.09	19.13
June	23.31	23.98	19.16	19.82
July	24.60	25.61	21.01	21.26
August	25.21	N/A	20.91	N/A
September	23.44	N/A	19.36	N/A
October	20.41	N/A	17.08	N/A
November	16.86	N/A	14.35	N/A

El Jaro Creek

Water temperature was monitored within El Jaro Creek, at a location approximately 50 feet upstream of the confluence with Salsipuedes Creek, for the period from late April, 1995 through early August, 1996 (Figure 3-48). Water temperature monitoring results from El Jaro Creek demonstrate both relatively high average daily water temperatures during the summer, but also correspondingly high maximum daily water temperatures. In 1995, maximum temperatures exceeded 24 C for 2 days in May, 11 days in June, 25 days in July, and 24 days in August (Table 3-5). In 1996, maximum temperatures exceeded 24 C on 10 days in June and 10 days in July. Both average and maximum temperatures exceeded 20 C during the summers of 1995 and to a lesser extent in 1996. Maximum temperatures occurred in July (26.5 C) and August (26.3 C) in 1995 and in May (26.5 C) and June (26.9 C) in 1995. In 1995, the 25 C criterion was exceeded in June (5 days), July (16 days), and August (9 days). In 1996, the 25 C criterion was exceeded only in May (4 days), and June (8 days).

Table 3-17 presents a summary of average monthly water temperatures during the spring and summer of 1995 and 1996 for comparison. Diel temperature variation within El Jaro Creek of up to 8.5 C has been observed during this monitoring period. The relatively high and sustained average daily temperatures during the summer, in combination with maximum daily temperatures over 26 C during both 1995 and 1996 are expected to contribute to physiological stress, reduced growth rates, and potentially incipient lethal conditions for rainbow trout/steelhead at this monitoring site.

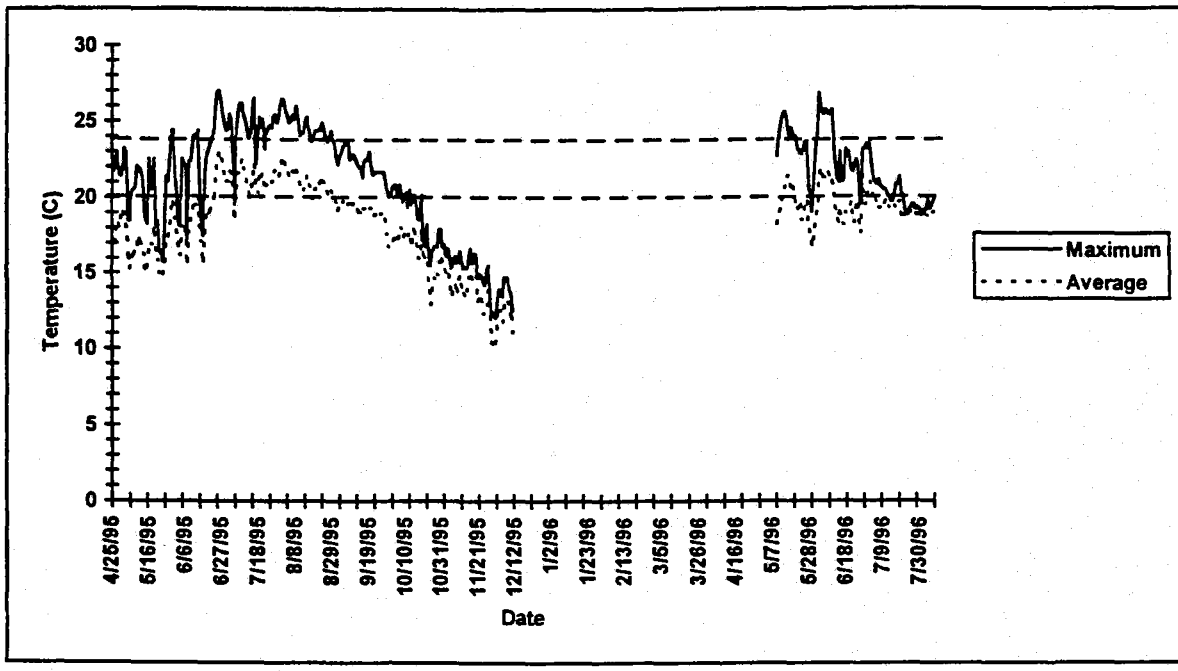


Figure 3-48. **Average daily and maximum water temperatures within El Jaro Creek, measured 50 feet upstream of the confluence with Salsipuedes Creek.**

Table 3-17. Comparison between monthly average maximum and monthly average water temperatures (C) within El Jaro Creek during 1995 and 1996.

Month	1995 Monthly Maximum	1996 Monthly Maximum	1995 Monthly Average	1996 Monthly Average
May	20.50	23.35	16.83	19.37
June	22.75	23.26	19.15	19.84
July	24.72	20.25	21.21	19.35
August	24.58	N/A	20.93	N/A
September	22.23	N/A	19.17	N/A
October	18.90	N/A	16.51	N/A
November	15.29	N/A	13.64	N/A

3.6 Summary

Mainstem Water Temperature

Results of water temperature monitoring on the Santa Ynez River have generally shown:

- Cachuma Reservoir becomes thermally stratified during the summer and fall and destratified (relatively uniform temperatures from the surface to the bottom) during the winter. During the period of stratification water temperature and dissolved oxygen concentrations are greatest in the upper part of the water column (epilimnion), with the coolest water temperatures and dissolved oxygen concentrations decreasing below 2 mg/l within the lower part of the water column (hypolimnion). After fall turnover, water temperature and dissolved oxygen concentrations (6-8 mg/l) were relatively consistent throughout the water column.

- Water temperature follows a general seasonal pattern with increasing temperatures during the spring and summer and decreasing temperatures during the fall and winter, coincident with the seasonal pattern in air temperature;

- Water temperature, particularly during summer, is lowest near Bradbury Dam, with a longitudinal gradient of increasing temperature moving downstream;

- Daily variation in water temperature, particularly during the summer, is generally lowest near Bradbury Dam, with a longitudinal gradient of increasing daily variation in water temperature at locations further downstream;

- Seasonal patterns of water temperature within the Santa Ynez River Lagoon are typically cooler, particularly during the summer, than water temperatures occurring at locations further upstream, with the exception of those immediately below Bradbury Dam;

- Information on thermal tolerance and the physiological response of rainbow trout/steelhead to elevated water temperatures (e.g., stress, reduced growth rates, etc.) are available primarily for steelhead stocks from the northern part of their geographic distribution (Oregon, Washington, and British Columbia). It has been hypothesized, however, that thermal tolerance of northern populations may be lower than the actual tolerance for stocks inhabiting the southern end of their geographic distribution. No definitive data are available on the thermal tolerances for southern steelhead stocks for use in developing thermal tolerance indices. Thermal tolerance criteria (frequency of average daily temperatures greater than 20 C, and frequency of maximum daily temperatures greater than 25 C) should, therefore, not be used as absolute thermal thresholds, but rather represent general guidelines for assessing the biological significance of water temperature conditions monitored during the 1993 - 1996 period of these investigations;

- Evaluation of average daily and maximum daily water temperatures, with respect to thermal tolerance for rainbow trout/steelhead, showed water temperatures are within acceptable ranges at all locations downstream of Bradbury Dam during the late fall, winter, and early spring;

- Water temperatures at a number of mainstem monitoring Sites exceeded temperature criteria (average daily water temperature greater than 20 C, or maximum daily temperature greater than 24 C) for rainbow trout/steelhead during the summer;

- The frequency and magnitude of daily temperatures that exceed criteria for rainbow trout/steelhead increased as a function of distance downstream from Bradbury Dam, with the exception of temperature conditions occurring within the lagoon;

- Results of temperature monitoring during the 1996 WR 89-18 releases showed that water temperatures increased rapidly, resulting in potentially adverse water temperatures for rainbow trout/steelhead at locations 3.4 miles and further downstream of the dam, despite instream flow releases of 50 to 135 cfs.

- Several temperature models have been developed for the lower Santa Ynez River based upon predicted environmental conditions and the use of empirical data in statistical regression analyses. Results of these models are generally consistent in describing the longitudinal gradient in water temperatures occurring at locations downstream of Bradbury Dam.

- Maximum water temperatures recorded from surface thermographs on one or more days during the summer months exceeded the incipient lethal threshold (>25 C) at the Refugio Habitat Unit X (3.4 miles downstream of Bradbury Dam), and at all habitat units monitored further downstream, with the exception of the lagoon. Except for Alisal Habitat Unit 48, bottom thermographs in pools never recorded temperatures exceeding 24 C.

- Temperature conditions monitored during 1995 and 1996 would be expected to result in physiological stress and/or mortality for rainbow trout/steelhead, thereby making summer habitat conditions unacceptable at a number of the locations monitored on the mainstem Santa Ynez River, however trout continued to occupy several locations, and appeared to remain in good health and increase in size;

- In summer, when flows are low (or at low flow releases), localized cool groundwater upwelling may provide acceptable conditions for rainbow trout/steelhead to successfully inhabit pools and other areas downstream of Bradbury Dam. The number of rainbow trout/steelhead inhabiting the Alisal reach remained relatively constant between August (34 fish) and December, 1995 (31 fish), despite elevated water temperatures during the later summer; and

- Data gaps and failure of temperature monitoring instruments at a number of the locations resulted in incomplete temperature monitoring records.

Mainstem Dissolved Oxygen

Results of dissolved oxygen monitoring within the mainstem Santa Ynez River have generally shown:

- Extensive algal production between late spring and early fall contributes to substantial diel variation in dissolved oxygen concentrations and may adversely affect habitat quality for resident fish;

- Dissolved oxygen concentrations at night (measured during pre-dawn surveys) showed dissolved oxygen concentrations within many habitats ranging from 1 to 3 mg/l;

- Low diel dissolved oxygen concentrations, measured at several habitat units, would be expected to result in severe physiological stress and/or acute mortality to many fish species (less than 2 mg/l);

- A vertical gradient in dissolved oxygen concentrations was observed at several deeper pool habitat units, with daytime dissolved oxygen concentrations being greatest near the surface, with a marked decline in dissolved oxygen near the bottom. A similar vertical gradient in water temperature was observed at many of these locations, with highest water temperatures near the surface, and lowest water temperatures near the bottom. These results are consistent with the hypothesis that vertical stratification becomes established within deeper pool habitats in the absence of significant flow. Vertical stratification within these habitats during the summer would present a potential conflict in habitat selection by species such as rainbow trout/steelhead in which areas of the habitat having sufficient dissolved oxygen concentrations may also have elevated, and potentially stressful, water temperature conditions;

- Rooted aquatic vegetation was abundant after high flows in 1995 removed accumulated filamentous algal mats;

- Early morning dissolved oxygen concentrations during the fall were substantially higher than those during the summer, coincident with a seasonal decline in algal cover and decreased temperatures; and

- River flow provided by the 1996 WR 89-18 releases was sufficient to remove much of the algae from pool habitats and create sufficient turbulence and mixing to sustain higher dissolved oxygen concentrations (7 mg/l) during the critical morning hours at any of the flows tested.

Santa Ynez River Lagoon

Results of water quality monitoring within the Santa Ynez River Lagoon have generally shown:

- No substantial differences were observed in water quality measurements (water temperature, dissolved oxygen, and salinity) across transects within the Lagoon, however, when the Lagoon was both open and closed, water quality differences were observed between upstream and downstream monitoring locations;

- The Lagoon water depth more than doubled at all sampling locations in 1995 after the Lagoon breach closed. Vertical gradients were observed in water temperature, dissolved oxygen, and salinity within deeper areas of the Lagoon during periods when the Lagoon breach was closed. Vertical stratification in water quality parameters varied substantially between locations and survey periods;

- Average daily and maximum daily water temperatures within the Lagoon during the summer were consistently lower than water temperatures measured at upstream monitoring locations, with the exception of locations immediately downstream from Bradbury Dam;

- Dissolved oxygen concentrations were generally greater than 5 mg/l in the upper three quarters of the water column during months when stratification within the Lagoon had developed. The lower one quarter of the water column had dissolved oxygen levels less than 4 mg/l, with concentrations less than 1 mg/l developing at the bottom one foot at most Sites;

- Salinity levels within the Lagoon followed a consistent longitudinal pattern, with salinity near brackish/full strength sea water at Ocean Park, decreasing to freshwater at the upstream location;

- Salinity level varied at each site between months, reflecting seasonal variation in the balance between freshwater inflow and tidal influence. Higher salinity concentrations were observed at high tide at all three sites, particularly when the Lagoon breach was open.

Tributary Water Temperature

Water temperature monitoring within various tributaries to the lower Santa Ynez River has shown:

<u>Hilton Creek</u>

- Summer (June-August) water temperatures in 1995 within Hilton Creek (250 feet upstream of the confluence with the Santa Ynez River) showed maximum daily water temperatures ranging from 16.4 to 26.3 C. Young-of-the-year rainbow trout/steelhead were observed to be generally healthy and actively feeding at temperatures up to 25.8 C within Hilton Creek. The observation of young-of-year rainbow trout/steelhead surviving and actively foraging within Hilton Creek at temperatures in excess of 25 C underscores the need to develop additional information regarding the thermal tolerance and response of rainbow trout/steelhead from the southern portion of their geographic range. Revised thermal tolerance criteria can then be used as a basis in evaluating temperature effects on habitat suitability within the lower Santa Ynez River and its tributaries. In the absence of more definitive information regarding thermal tolerance and the biological response of these fish to elevated temperature conditions, it is difficult to establish site-specific alternative temperature criteria and guidelines for use in these analyses.

Reconciliation between the biological observations on the distribution and condition of rainbow trout/steelhead within the lower Santa Ynez River and tributaries, and the associated temperature monitoring results, will be important as these investigations proceed and various alternative management actions are identified and evaluated as part of the lower Santa Ynez River program. Young-of-year rainbow trout/steelhead were observed within Hilton Creek only until July, 1995. After July surface flow within the creek was lost and the creek dewatered. Numerous young-of-year rainbow trout/steelhead were observed to have died prior to rescue operations. Water temperatures exceeded the potential incipient lethal threshold (25 C) for rainbow trout/steelhead within Hilton Creek in July and August, 1995;

- A deeper water pool (upper Shute Pool) exists within Hilton Creek immediately downstream of the potential fish passage barrier, located approximately 1,200 feet upstream of the confluence, which represents an area where adult rainbow trout/steelhead may accumulate and/or juvenile rearing may occur. Summer water temperatures within the pool were substantially lower than temperatures measured within Hilton Creek further downstream. Water temperatures within the pool may be suitable through at least August to provide habitat for rainbow trout/steelhead, although the pool would be physically isolated from fish movement either upstream or downstream during at least a portion of the year; and

- The deeper water pool on Hilton Creek was observed to persist into the summer during 1995, a high precipitation year. This pool did not persist throughout 1995, and was not observed to persist through the summer of 1996. Seasonal patterns in surface flows and the persistence of the deeper pool within Hilton Creek varies from one year to the next depending upon precipitation and runoff within the watershed.

Nojoqui Creek

- Average daily and maximum daily water temperatures within Nojoqui Creek exceeded the 20 and 25 C temperature criteria during the summer of 1995 and 1996. Water temperatures exceeded the potential incipient lethal threshold (25 C) during June - August, 1995, and June, 1996;

Salsipuedes Creek

- Upper Salsipuedes Creek is characterized by having an intact riparian corridor with abundant canopy within which water temperatures were substantially cooler than those observed in either El Jaro or lower Salsipuedes Creek. The streambed is wider and the canopy less abundant in the lower section of Salsipuedes Creek, which may also contribute to the higher observed water temperatures within this reach of the tributary. Water temperatures did not exceed 25 C in either 1995 or 1996. At no time did average daily temperatures exceed 20 C. The data available on seasonal flows within the creek during the summer of 1995 and 1996 is not, however, adequate to evaluate the effects of flow on inter-annual temperature differences;

<u>El Jaro Creek</u>

- Inflow during the summer from El Jaro Creek contributed to substantially higher average daily and maximum daily water temperatures within lower Salsipuedes Creek. Average daily and maximum daily temperatures within Salsipuedes Creek downstream of the confluence with El Jaro Creek exceeded the 20 and 24 C temperature criteria in both 1995 and 1996. Maximum daily temperatures exceeded 27 C on occasion in both 1995 and 1996, representing conditions potentially above the incipient lethal level for rainbow trout/steelhead;

- Water temperature monitoring data during the summer months from El Jaro Creek confirmed higher average daily and maximum daily water temperatures than those observed within upper Salsipuedes Creek. The relatively and sustained average daily temperatures during the summer, in combination with maximum daily temperatures over 26 C during both 1995 and 1996 within El Jaro Creek are expected to contribute to physiological stress, reduced growth rates, and potentially incipient lethal conditions for rainbow trout/steelhead; and

- Rainbow trout/steelhead have been observed during snorkeling surveys in numerous habitat units in El Jaro Creek, including young-of-year and size classes up to approximately 8-10 inches (observed during the summer, 1996). As noted above, additional information needs to be developed as part of the long-term study plan, regarding the thermal tolerance, physiological and behavioral response, and microhabitat selection by rainbow trout/steelhead in response to water temperature conditions and the biological significance of water temperatures observed in tributaries such as El Jaro Creek on the health of individuals, potential mortality, and population abundance, particularly during summer conditions when temperatures within these tributaries are elevated.

4.0 HABITAT CHARACTERISTICS

The quantity and quality of physical habitat available within the Santa Ynez River and its tributaries play an important role in determining the potential of the river to support fish populations. Physical habitat consists of such parameters as the amount of space available, water depth, current velocity, substrate, availability of cover, water temperature, and water chemistry characteristics. These parameters can be influenced by river flow. Habitat mapping surveys have been conducted in parts of the Santa Ynez River and its tributaries to assess the quantity and quality of physical habitat available.

These surveys measured the areal extent of distinct types of habitat (riffles, pools, runs, etc.) that have different characteristics of water velocity and depth. Riffles are high gradient areas with shallow depth and relatively fast water velocities. Runs have a lower gradient than riffles and are generally deeper, with uniform water velocity and without surface turbulence. Pools are characterized by low surface gradient and low water velocity and are generally deeper than riffles and runs. Because of these characteristics, and because species and life-stages of fish vary in their habitat preferences, habitat types have differing potentials for supporting populations of fish. Other important habitat features such as substrate, cover, instream vegetation, and riparian canopy were also measured during these surveys.

4.1 Santa Ynez River Mainstem

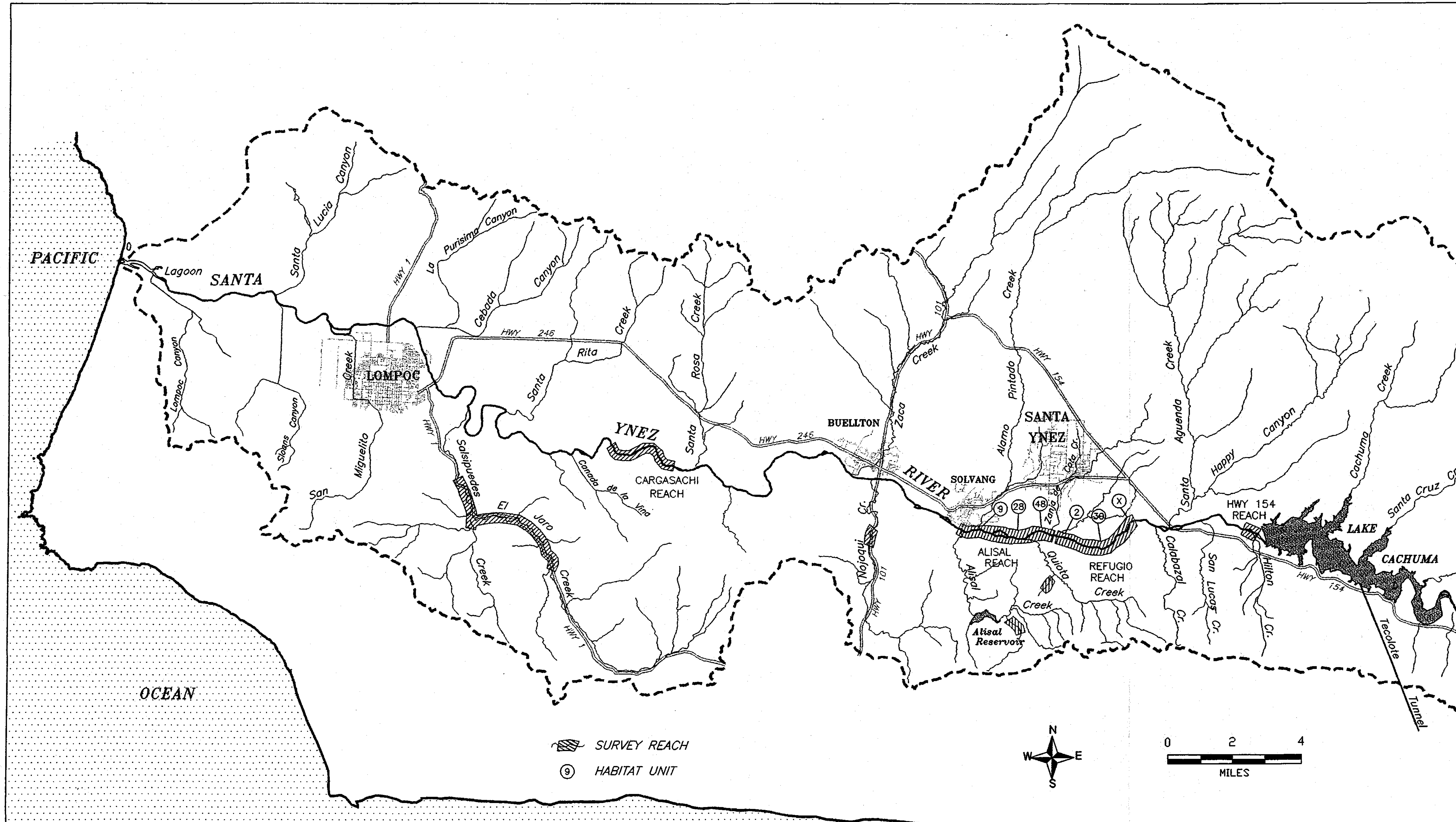
Habitat observations were made during WR 89-18 releases in October and November of 1994 and two major habitat surveys were conducted on the mainstem Santa Ynez River: one in 1994 and one in 1995. In addition, habitat conditions were surveyed monthly in selected habitats between August, 1995 and August, 1996.

River flow is an important factor determining habitat characteristics. Flow in the river downstream of Bradbury Dam comes from tributaries, water released from Lake Cachuma as spill or controlled releases for groundwater recharge, flood control, or other purposes (Section 2). During the 1994 survey, minimal releases were made and flow was intermittent by mid-May in the reach between Bradbury Dam and Refugio Road. Between Refugio Road and Buellton several tributaries contribute additional flow and in 1994 the river was flowing near Alisal Bridge into June. The winter of 1994-95 had high runoff and spill from Bradbury Dam and during the 1995 survey, flow was low but contiguous in most of the survey reaches except for a mile long section in the Refugio reach that was dry. Portions of the Alisal reach were also dry. During the winter of 1995-96, flow increased periodically due to local runoff but the river became increasingly dry between April and July. A half-mile section of upper Refugio reach was dry by the end of April and the Refugio, Alisal, and Cargasachi reaches were largely dry by July (Ed Ballard, pers. comm.).. In July, 1996, releases from Bradbury Dam under WR 89-18 led to flow increases downstream as far as Lompoc.

Instream Habitat Types

<u>Habitat Mapping</u>

In the late winter and early spring of 1994, Entrix (1995) surveyed the mainstem between Highway 101 in Buellton and Bradbury Dam and a two mile section downstream of the water treatment plant in Lompoc. The river upstream from Buellton was further subdivided into a reach from Buellton to



STETSON ENGINEERS INC.

FISHMAP.DWG

Figure 3.1-1.
Location of Fishery Survey Reaches nd and Habitat Units on the Mainstem of Santa Ynez River and Tributaries

Refugio Road (6.25 miles in length) and a reach from Refugio Road upstream to Bradbury Dam (nearly eight miles).

The reach from Bradbury Dam to Refugio Road was dominated by shallow pools (less than three feet deep), which accounted for 57 percent of the total reach length (Table 4-1).

Table 4-1. Habitat types mapped during 1994 habitat survey.

Habitat Type	Above Refugio Road		Below Refugio Road		Near Lompoc	
	Length (ft)	Percent	Length (ft)	Percent	Length (ft)	Percent
Deep Pool	6509	15.5	11362	34.4	5725	50.7
Shallow Pool	23931	56.9	9282	28.1	1339	11.9
Riffle	1500	3.6	1211	3.7	81	0.7
Run	9152	21.8	11134	33.8	4140	36.7
Dry Channel	975	2.3	-	-	-	-
TOTAL LENGTH	42067		32989		11285	

Run habitat comprised 22 percent of the reach, deep pool habitat made up 15 percent and riffle habitat made up four percent. The reach from Refugio Road to Buellton was approximately 6.25 miles long with deep pool and run habitat each comprising 34 percent of the reach and shallow pools accounting for 28 percent of the habitat. Riffles accounted for only 4 percent of the reach length. Habitat in the two miles below the Lompoc wastewater treatment facility was dominated by deep pools formed by numerous beaver ponds. These formed 50 percent of the reach length. Runs were also extensive, accounting for 37 percent of the reach, while shallow pools and riffles accounted for 12 percent and 1 percent, respectively.

Habitat surveys conducted by Entrix indicated that much of the length of the Santa Ynez River between Buellton and Bradbury Dam was composed of areas where the flow of the river was split between two or more channels over some range of flow. Since the Entrix survey, high flows during the winter of 1994-95 scoured a more confined channel through much of the river. Only a few sections currently have a split or braided channel and most are located downstream of Salsipuedes Creek. High flows during the winter may also have altered the relative abundance and location of different habitat types.

In July 1995 the SYRTAC surveyed three separate reaches between Alisal Bridge and Bradbury Dam and a reach near Lompoc (Figure 4-1). A total of approximately seven miles were surveyed in the four reaches. The Highway 154 reach extended from the tail of the spill basin at Bradbury Dam downstream ¼ mile. The Refugio reach extended from approximately one mile downstream of the Highway 154 bridge downstream to Refugio Road, for a total length of about 2.5 miles. The Alisal reach extended from Refugio Road downstream to Alisal Road, a distance of three miles. The Cargasachi reach was a 1.5 mile section located in the lower portion of the river approximately 20 miles upstream from the lagoon. High flows during the winter of 1994-95 (Section 2), in the interval between the Entrix and SYRTAC surveys, altered channel conditions and habitat parameters.

The SYRTAC surveyed the Santa Ynez River mainstem in July at a flow of 5-10 cfs. The survey found that the Highway 154 reach was dominated by three pools including one pool that accounted for 67 percent of the total reach length. The remaining 20 percent of the reach was in shallower, flowing run and riffle habitat (Table 4-2). The relative proportion of pool habitat decreased with distance downstream from the Highway 154 reach. Pools comprised 34 percent of the Refugio reach, 14 percent of the Alisal reach and only 7 percent of the Cargasachi reach. Dry channel was not measured, but probably accounted for about 1 mile of the Refugio reach, and some of the Alisal reach. These characteristics, together with other habitat features, can have a major influence on the distribution of various fish species. For example, the majority of rainbow trout/steelhead larger than 6 inches were found in pool habitats in the Santa Ynez River and all size classes of largemouth bass were more abundant in pools than in run or riffle habitat (see Section 5).

Table 4-2. Habitat types mapped in Santa Ynez River mainstem during 1995 habitat survey.

Habitat Type	Highway 154 reach		Refugio reach		Alisal reach		Cargasachi reach	
	Length	Percent	Length	Percent	Length	Percent	Length	Percent
Run	265	15	4720	60	9925	72	6582	88
Pool	1487	80	2684	34	2045	15	117	2
Riffle	96	5	472	6	1835	13	739	10
TOTAL LENGTH	1848		7876		13805		7438	

Seasonal and Permanent Pools

Pools, particularly deep pools, provide habitat for juvenile and older age classes of rainbow trout/steelhead, and all age classes of largemouth bass and sunfish. In SYRTAC surveys conducted in the mainstem in 1995, all rainbow trout/steelhead greater than 12 inches and the majority of trout 6-12 inches in length were seen in pools (Section 5.1). Rainbow trout/steelhead have been seen over the summer in pools in the mainstem as far as 9.5 miles downstream from Bradbury Dam. In addition, one rainbow trout/steelhead (estimated at over 12") was seen in August, 1996 in the vicinity of the Weister Ranch (approximately 15 miles downstream of Bradbury Dam).

Entrix surveys in 1994 found that deep pools (greater than three feet deep) were most abundant in the Lompoc reach accounting for 50 percent of the reach length (Table 4-1). In the Entrix study, deep pools accounted for over a third of the reach between Buellton and Refugio Road but only 15 percent of the reach between Refugio Road and Bradbury Dam. Discharge from the wastewater treatment plant in Lompoc may provide year-round water to the reach downstream and rearing habitat may be available in some of the beaver ponds, but high water temperatures and the abundance of bass and sunfish may make these ponds unsuitable for rearing rainbow trout/steelhead.

The SYRTAC habitat survey in 1995 found almost the opposite condition with respect to distribution of pools within the river. In the SYRTAC survey pools comprised over 80 percent of surveyed habitat immediately downstream of Bradbury Dam. Pools decreased to 34 percent of the total in the Refugio reach, 15 percent in the Alisal reach, and only 2 percent in the Lompoc reach (Table 4-2). The surveys are not directly comparable since the Entrix survey covered the entire length of river between Buellton and Bradbury Dam while the SYRTAC survey samples covered only portions of the reach. Some of the observed differences in pool habitat may also be related to changes in the channel configuration caused by high flows between the two surveys. Many of the beaver dams creating pools in the reach near Lompoc during the Entrix survey were likely washed out during the high flow period.

The SYRTAC survey in July, 1995 indicated that average pool depth was least in the Cargasachi reach (Table 4-3). The deepest pools were in the Highway 154 and Alisal reaches where maximum depth averaged 5 feet and the deepest pools were close to 10 feet deep. Pools in the Refugio reach were only slightly more shallow (Table 4-3). Very little comparable data has been collected in the tributaries. This is discussed further in Section 6.3.

Table 4-3. Comparison of Habitat Characteristics in Surveyed Reaches of the Santa Ynez River and its Principal Tributaries Downstream of Bradbury Dam as Measured in July 1995.

	Mainstem				Tributaries					
	Hwy 154 Reach	Refugio Reach	Alisal Reach	Carghasachi Reach	Hilton Creek	Quiota Creek	Alisal Creek	Nojoqui Creek	Salsipuedes Creek	El Jaro Creek
Survey Date	Jul-95	Jul-95	Jul-95	Jul-95						
Approximate Flow (cfs)	5	3.4	11	10	0.5	3				
Length Surveyed (miles)	0.3	1.5	2.7	1.4	0.19			2.3		1.6
Habitat Units Classified	14	34	51	30	37					
Dry or Intermittent Streambed (%)	0%		0%	0%						
Mean Wetted Width (ft)	27	48	52	33	9					
Mean Depth (ft)	1.0	1.4	1.5	0.7						
Pool Habitat (% of Total Length Surveyed)	81%	34%	15%	2%	26%					
Average of Mean Pool Depths (ft)	2.7	2.2	2.8	1.5						
Average of Maximum Pool Depths (ft)	5.0	3.9	5.0	2.7						
Gradient (%)										
Dominant Substrate	Small Cobble	Small Cobble	Small Cobble	Gravel						
Sub-dominant Substrate	Large Cobble	Gravel	Gravel	Small Cobble						
Average Canopy Coverage (%)	48%	3%	3%	11%	NR					
Average Surface Algae Coverage (%)	1%	68%	60%	30%						
Average Cover (% of Unit Area)	62%	72%	64%	33%						
Total Steelhead/Rainbow trout Spawning Area (sq ft/mile)									1800	650
Source	TAC 1995	TAC 1995	TAC 1995	TAC 1995	TAC 1995	Entrix 1994	Entrix 1994	Entrix 1994	Entrix 1994	Entrix 1994

NR : Not Recorded

Observations during 1994 WR 89-18 Releases

In the mainstem Santa Ynez River, habitat mapping surveys were conducted at three sites in 1994 to document the influence of flow changes on the areal extent and quality of instream habitat. WR 89-18 releases in August and September ranged from about 150 cfs in early August, to less than 60 cfs in late September. The study began on October 22, 1994 and continued until November 5, 1994. During this period releases from Bradbury Dam were at 15 cfs for two days, then were reduced to 10 cfs for four days, 5 cfs for two days, and 1 cfs for two days. Habitat characteristics were observed at three separate study sites. Site 1 was located directly below the tail section of the spill basin. The site runs approximately 40 m (130 feet) downstream to the confluence pool formed by Hilton Creek and the Santa Ynez River. Site 2 was a 52 m (170 foot) section located near Solvang, roughly 9 miles down river from Bradbury Dam across from the Alisal Golf Course. Site 3 was located approximately 35 miles down river from Bradbury Dam, directly upstream from the Highway 246 bridge in Lompoc. Observations at these sites were made on two occasions; once at the beginning of the study, and again when flows were reduced to one cfs.

The largest change in channel width and depth were at Site 1, closest to the dam (Table 4-4). Riffles and runs were the habitats most affected. Two small pools remained in Site 1 after the riffles and runs became dewatered. Flows did not recede as much at Sites 2 and 3 due to accretion flows from groundwater and tributaries, and to lower initial flows. Flow at Site 2 continued at approximately 3.6 cfs for several months after completion of the WR 89-18 release. Several tributaries contribute to the Santa Ynez River upstream of Site 3 including Salsipuedes Creek and these may have contributed to the observed flows. Slight variations in depth were observed depending on the time of day with depths measured in the morning slightly greater than those measured in the afternoon (0.5 to 0.75 inch difference).

Table 4-4. Change in channel characteristics during WR 89-18 releases.

	Approximate Release Rate		Percent Change
	15 cfs	1 cfs	
Average Channel Width (ft)			
Site 1	35.4	18.0	49%
Site 2	38.0	28.2	26%
Site 3	36.4	30.2	17%
Average Depth (ft)			
Site 1	8.7	5.2	40%
Site 2	6.5	5.3	18%
Site 3	4.2	3.5	17%

Mainstem Monthly Habitat Mapping, 1995-96

Basic habitat features have been mapped by the SYRTAC in each of the four mainstem reaches on a monthly basis between August 1995 and August 1996. Evaluation of changes in habitat volume for those habitat units that were consistently measured during this period provides information on how the available habitat changes during the season, with different release levels, and from year to year.

Habitat volume (calculated as the product of mean length, mean width, and mean depth at each survey) gives an estimate of the gross amount of habitat available for fish in the Lower Santa Ynez River. The habitat actually useable for a given species may be reduced below this gross amount by other factors such as temperature suitability, dissolved oxygen levels, and micro-habitat features such as current velocity, depth, and substrate conditions. Evaluation of change in habitat volume gives a very general picture of changes in habitat that should not be viewed in isolation from other factors. This analysis is most useful for evaluating seasonal change in habitat within each reach. Comparisons between reaches are less useful since only a portion of each reach is represented.

Five habitat units were consistently measured in the Highway 154 reach. One of these, the Long Pool, dominated the habitat volume in all surveys (Figure 4-2). Run and riffle habitat occurred at intervals in negligible amounts. The volume of the Long Pool had a persistent base level of 15-16 acre-feet, with minimum volume occurring in August 1995, and May 1996. Volume increased through the fall and early winter of 1995 and peaked in January of 1996. Increase between August and September was related to an increase in mean depth from 4.4 to 6.2 feet and may have been an artifact of variability in the sampling method rather than a true change in volume. No releases were made from Bradbury Dam during the winter of 1995-96 so any changes in habitat volume would have been related to inflow from Hilton Creek, stormwater runoff and change in evaporation and transpiration. In mid-July 1996 releases from Bradbury Dam of 135 cfs were initiated under WR 89-18. There was a small increase in habitat volume of the Long Pool as measured in July and August surveys. Habitat volume in runs was converted to riffle, but remained at negligible levels (Figure 4-2).

In the Refugio reach, 10 habitat units were consistently measured between July 1995 and August 1996 (Figure 4-3). Pools provided the majority of habitat volume throughout much of the period. As in the Highway 154 reach there was some increase in habitat volume during the winter of 1995-96. Habitat volume gradually diminished during the spring and summer of 1996 with the reduction apparently accelerating into June. River habitat disappeared by May with only isolated pools remaining. Releases under WR 89-18, beginning in mid-July 1996, converted pool habitat in the Refugio reach to run habitat with an overall increase in habitat volume. Habitat was probably reduced between the June 19 survey and the initiation of WR 89-18 releases almost a month later. In qualitative visual surveys on July 16, two of the habitat units were dry and a third was nearly dry. Other habitats were reduced to small isolated pools with turbid water. Reduction in habitat volume appeared to be greater in the summer of 1996 (following a winter with approximately normal runoff) than during the summer of 1995 (following a winter with a wet runoff pattern).

In the Alisal reach, evaluation of habitat volume was based on seven habitat units (Figure 4-4). Although data was generally recorded in 10 habitat units, data for at lease one month was missing from three of them. Those three were omitted from the analysis. The pattern of change was similar to the Refugio reach except that reduction in habitat volume during the summer of 1996 was

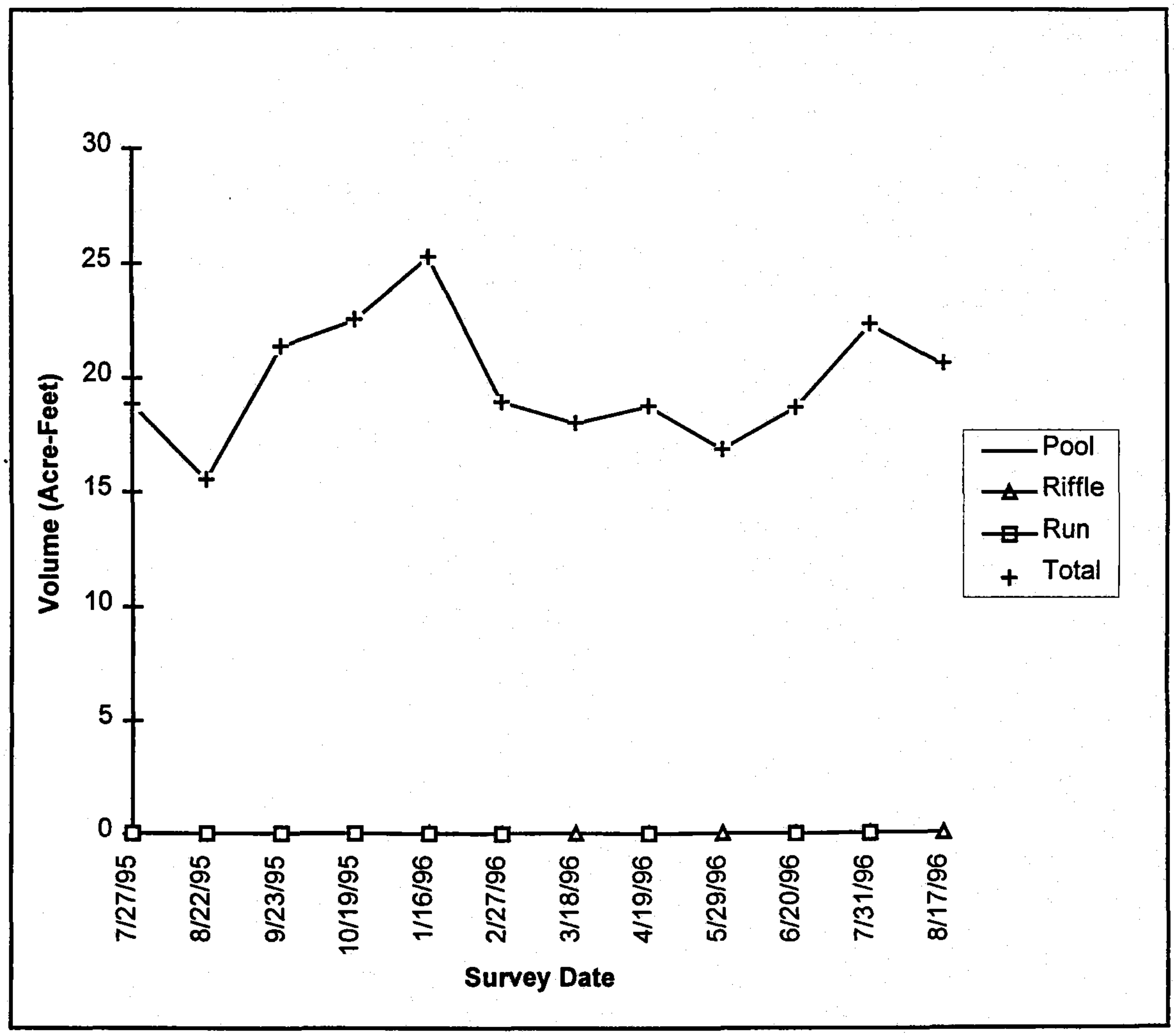


Figure 4-2. Highway 154 reach habitat volume.

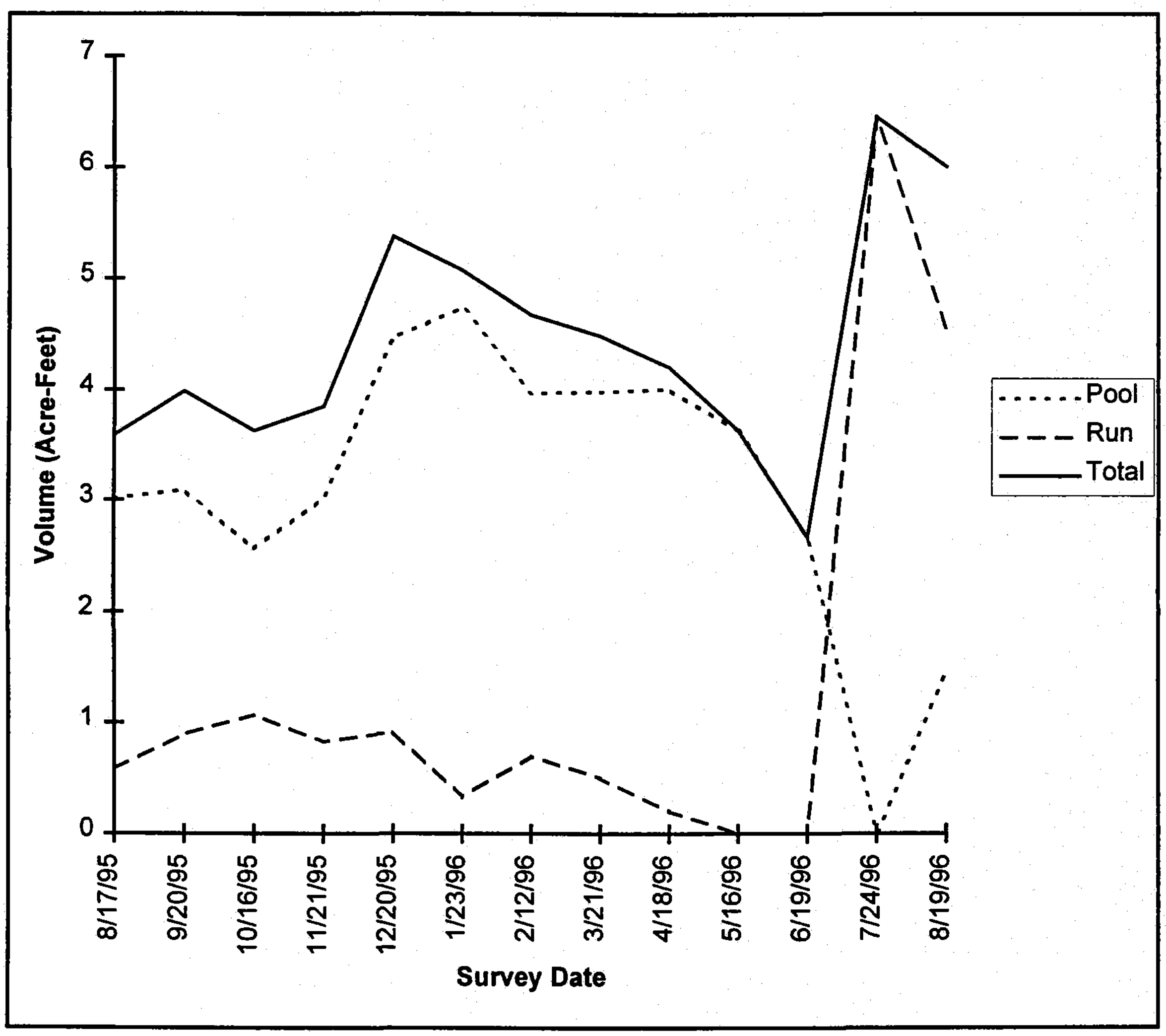


Figure 4-3. Refugio reach habitat volume.

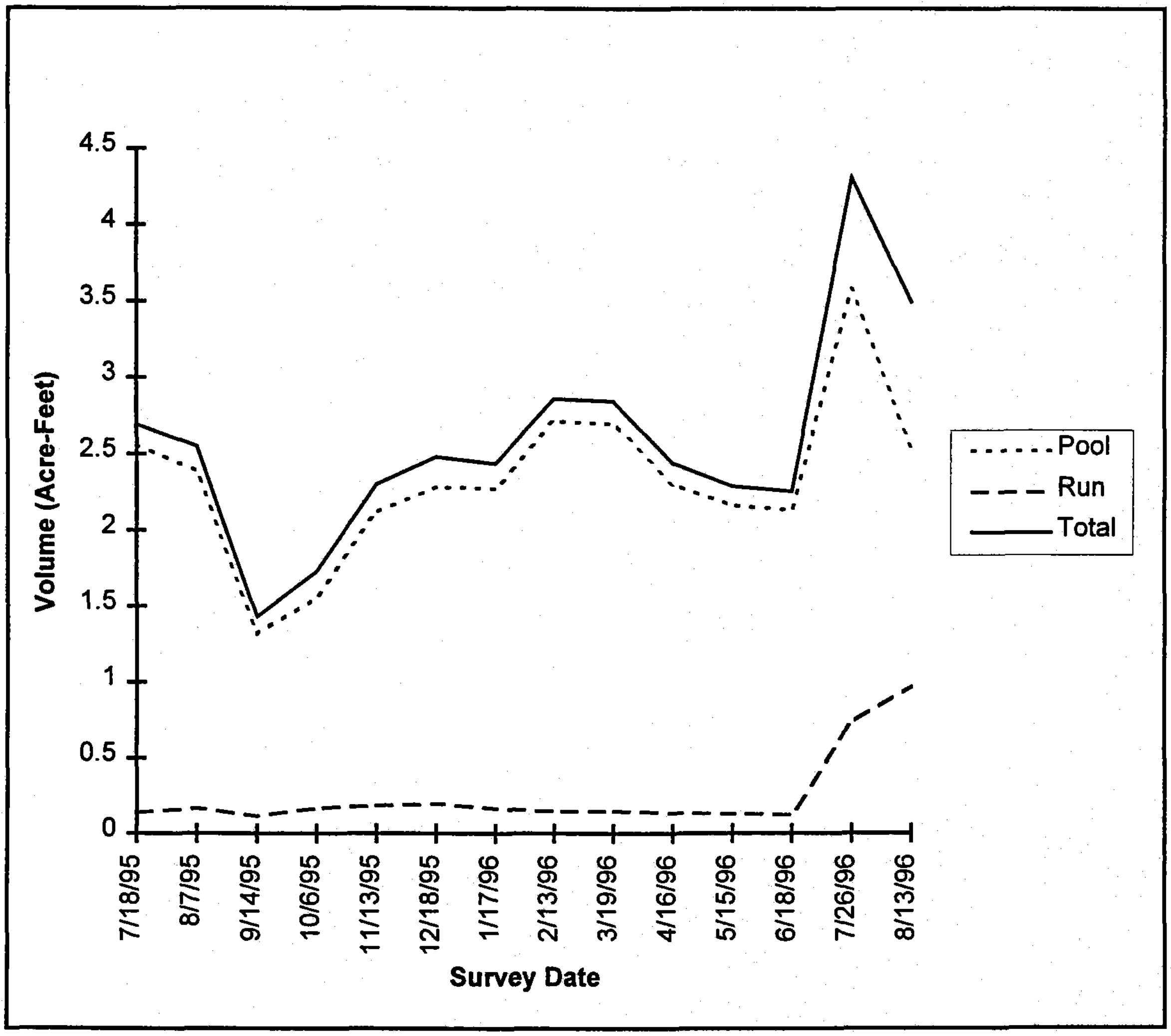


Figure 4-4. Alisal reach habitat volume.

less severe. During 1995, habitat volume decreased significantly between the August and September surveys. Habitat volume in the Alisal reach during July and August of 1996 was at higher levels than in 1995 due to WR 89-18 releases. Although conditions probably worsened between the June 18 survey and initiation of the WR 89-18 release almost a month later qualitative observations on July 16 indicate that none of the seven habitats went dry. Many of the habitat units did become isolated and turbid as in the Refugio reach. In one unit it was noted that a number of largemouth bass, sculpin, and stickleback had recently expired.

Habitat in the Cargasachi reach changed in a similar pattern as in upstream reaches (Figure 4-5). Habitat volume peaked in January, 1996, and during WR 89-18 releases in July, 1996. Volume appeared to decline to lower levels in early summer, 1996, than they had by late summer in 1995.

Instream Flow Modeling

Entrix (1995) conducted a habitat analysis using the Instream Flow Incremental Method (IFIM) Physical Habitat Simulation (PHABSIM). The analysis consisted of hydraulic modeling and linkage with fish habitat preferences established in the fisheries literature. A full discussion of the analysis is reported in Entrix (1995). A summary of key features of the analysis is as follows:

- The modeling used data collected in 1988 as part of the evaluation of the Cachuma Enlargement Project conducted by the California Department of Water Resources (DWR). Data were from 40 transects located between San Lucas Ranch and Buellton;
- Entrix updated the DWR models and reconfigured them as habitat-based models rather than the "representative reach" approach used by DWR;
- Entrix also included transect data from backwater and side channel portions of ten transects collected by DWR but omitted from the DWR model;
- The revised, habitat based, models were based on habitat mapping completed by Entrix in early spring 1994. In the revised models, the transects from San Lucas and the Highway 154 site were used to model the habitat above Refugio Road, while the transects from the remaining sites were used to model the habitat of the segment below Refugio Road; and
- The winter steelhead habitat suitability criteria of Bovee (1978) were used to interpret the results of the hydraulic simulations and calculate weighted usable area versus flow relationships.

Entrix presents the following conclusions from this analysis:

- Weighted useable area (WUA), an index of habitat availability, for spawning steelhead is very low at a flow less than 25 cfs, increases gradually from 25 cfs to about 150 cfs, and increases more steeply from 150 cfs to 300 cfs, the highest modeled flow. If "ideal" substrate conditions are assumed above Refugio Road, the modeling results show higher amounts of WUA at any given flow and more rapid increase in WUA with increase in flow;

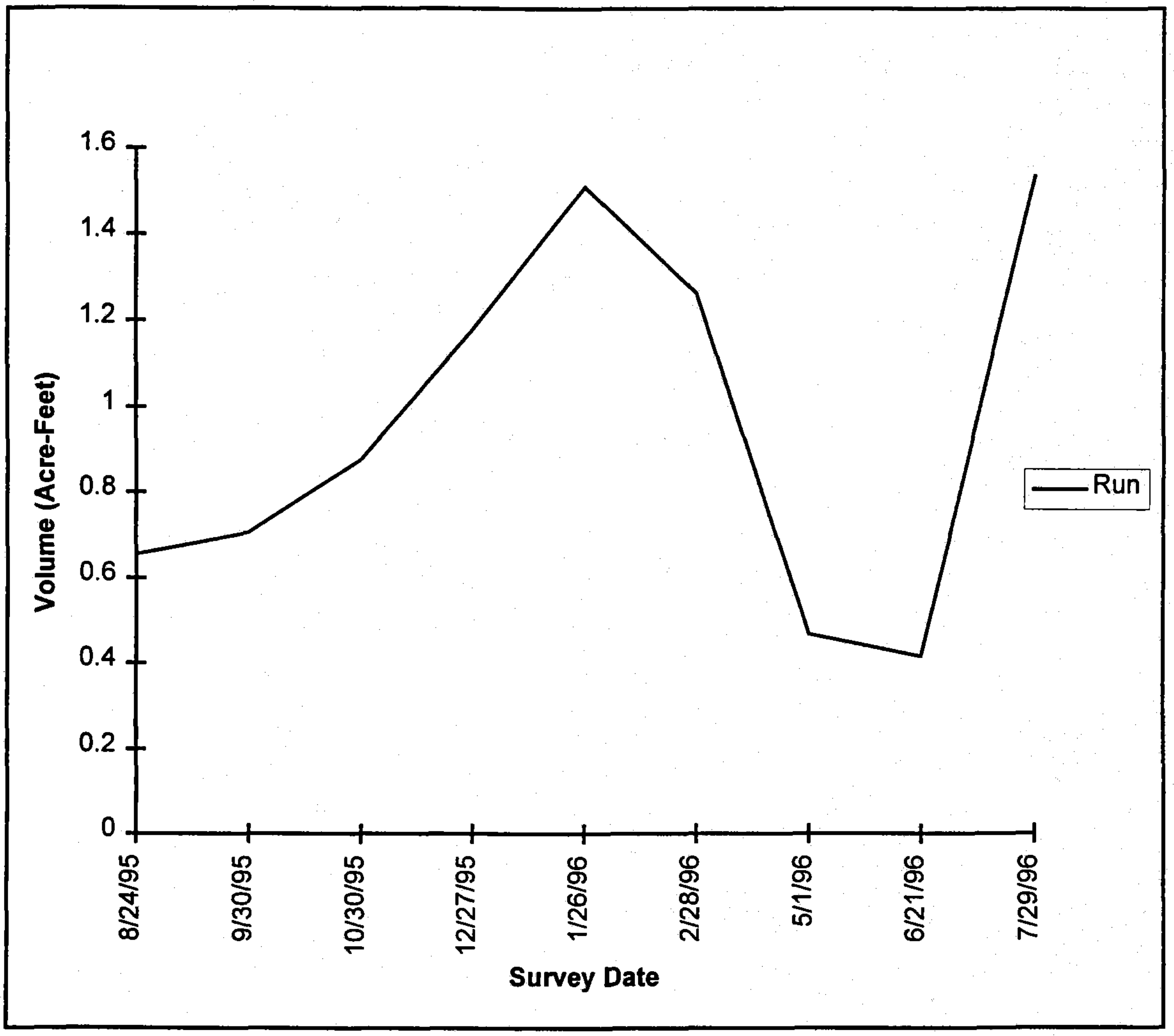


Figure 4-5. Cargasachi reach habitat volume.

- The WUA for fry increased rapidly as modeled flow increased from 5 to 30 cfs and was stable thereafter. WUA for juvenile steelhead increased rapidly to about 80 cfs and then increased only slightly with modeled flow increases to 300 cfs. If "ideal" substrate conditions throughout the reach are assumed for fry, WUA for fry is substantially greater than under existing substrate conditions;

- Heavy accumulations of fine sediments were observed in a majority of habitats surveyed in the Refugio reach during 1996. New substrate surveys may be needed to accurately model this reach; and

- It is unlikely that "ideal" substrate conditions for either spawning or fry would ever be achieved.

The results of the IFIM analysis were used by Entrix, together with various assumptions relating to generalized steelhead population biology, to evaluate limiting factors for steelhead. Entrix concluded that existing fry rearing habitat is insufficient to support the number of fry that could potentially be produced from spawning in the reach. Assumptions in this analysis included:

- Spawning flow of 48 cfs
- 651 Spawning pairs in the reach;
- Embryo survival to emergence of 40 percent;
- 0.3 Fry rearing per square foot of WUA;
- 25 Percent survival from fry to juvenile stage; and
- Density of rearing juveniles assumed for the analysis was not stated.

The results of the IFIM study should be interpreted in light of the following considerations:

- Although IFIM is the methodology developed and accepted by the USFWS and accepted by the CDFandG, the methodology has been criticized on a number of technical points and is not universally accepted by fisheries scientists;

- The IFIM analysis considers habitat conditions related to water depth, velocity, and substrate. Other factors may affect steelhead populations and need to be resolved when analyzing the effects of modeled variables. These factors include temperature, dissolved oxygen, food availability, disease, predation, and interactions with other species;

- The IFIM study conducted by Entrix does not account for potentially important habitat for rainbow trout/steelhead in isolated pools occurring during conditions of little or no flow in the Santa Ynez River identified in 1995;

- Changes in channel configuration occurred with high flows in the winter of 1995, after Entrix completed habitat mapping integral to the IFIM analysis. Subsequent habitat surveys indicate that there may have been substantial change in the types of habitat occurring in the study reach;

- Neither the IFIM nor the limiting factor analysis account for potential rearing habitat in the Santa Ynez River lagoon or tributaries; and

- Results of the limiting factor analysis are dependent on the IFIM model results and on assumptions regarding important population parameters for steelhead. These parameters can vary widely within and among different populations. Further, they are very difficult to measure under field conditions, and have not been measured in the Santa Ynez River.

The USFWS has reviewed the IFIM studies conducted by DWR and Entrix and believes that the transects selected do not adequately represent fish habitat in the river (Ed. Ballard, personal communication, November, 1996).

Riparian Vegetation

Riparian vegetation can be an important component of fish habitat in that it moderates thermal gain from solar radiation and can be an important source of nutrients in aquatic food chains. This habitat feature was incorporated into habitat surveys by estimating the amount of canopy coverage for each habitat unit. In most areas, riparian vegetation in the Lower Santa Ynez River is not well developed, and does not provide significant shading for aquatic habitats. The SYRTAC habitat survey found moderate levels of canopy coverage in the Highway 154 reach and low levels in the Refugio, Alisal, and Cargasachi reaches (Table 4-3, Figure 4-6).

Instream Vegetation

Aquatic vegetation can occur as rooted submerged plants, emergent plants such as cattails, and attached or floating algae. Instream vegetation can provide cover and shade for smaller fishes and may be an important food base either directly or in the production of aquatic insects or other invertebrates. However, extensive aquatic growth may also lead to depressed levels of dissolved oxygen during the night or late in the season (late summer - fall) as the algae die and decompose (Section 3.2). The character and amount of instream vegetation is often indicative of other habitat conditions such as water temperature and nutrient levels.

Surveys by the SYRTAC have indicated that instream vegetation in the form of floating algal mats can be extensive during the summer, particularly in the lower reaches of the river (Table 4-3, Figure 4-7). In July 1995, algal mats were extensive in the Refugio and Alisal reaches, covering an average of at least 60 percent of the aquatic habitat surface area. Coverage was lower in the Cargasachi reach and extremely low in the Highway 154 reach, on average covering only 1% of the surveyed habitat area in the Highway 154 reach. Observations later in the summer indicated that algae became abundant in some pools in the Highway 154 reach, particularly in the Long Pool. Differences in algal growth may be related to differences in water temperature, nutrient levels, flow, and/or photo period. Temperatures in summer are generally coolest near the dam and increase downstream. Nutrient levels have not been measured.

During snorkel surveys of the Long Pool in 1994, abundant amounts of aquatic algae was observed growing up from the bottom. Oxygen production was observed in the form of visible bubbles floating from the plants to the water surface. Daphnia populations were very dense. Upwelling of cool water was felt in several areas of the Long Pool. Observations at the Long Pool in 1994 indicated that surface algae was extensive prior to WR 89-18 releases, but disappeared after the release was begun.

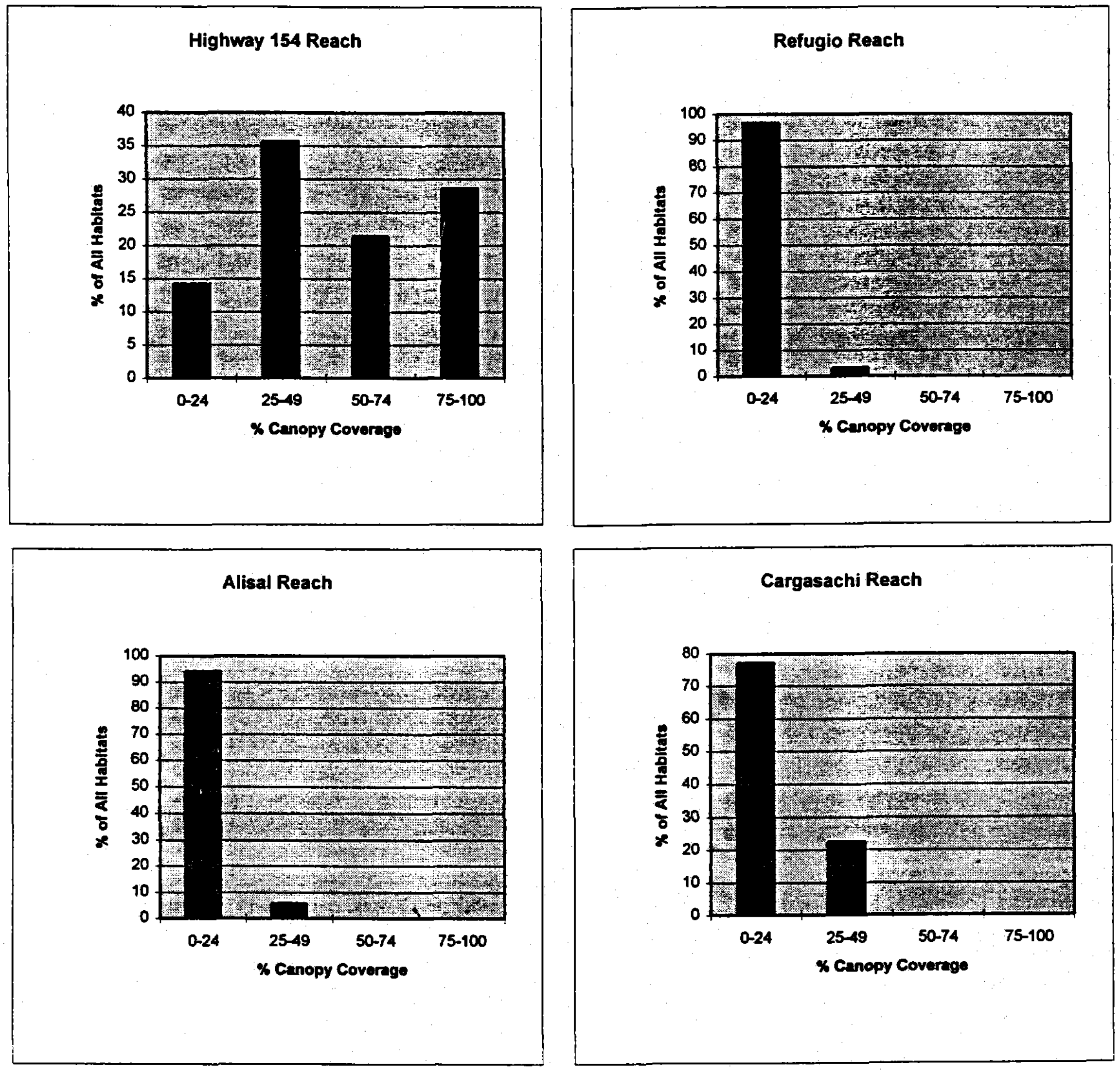


Figure 4-6. Canopy characteristics in Santa Ynez River mainstem, July, 1995.

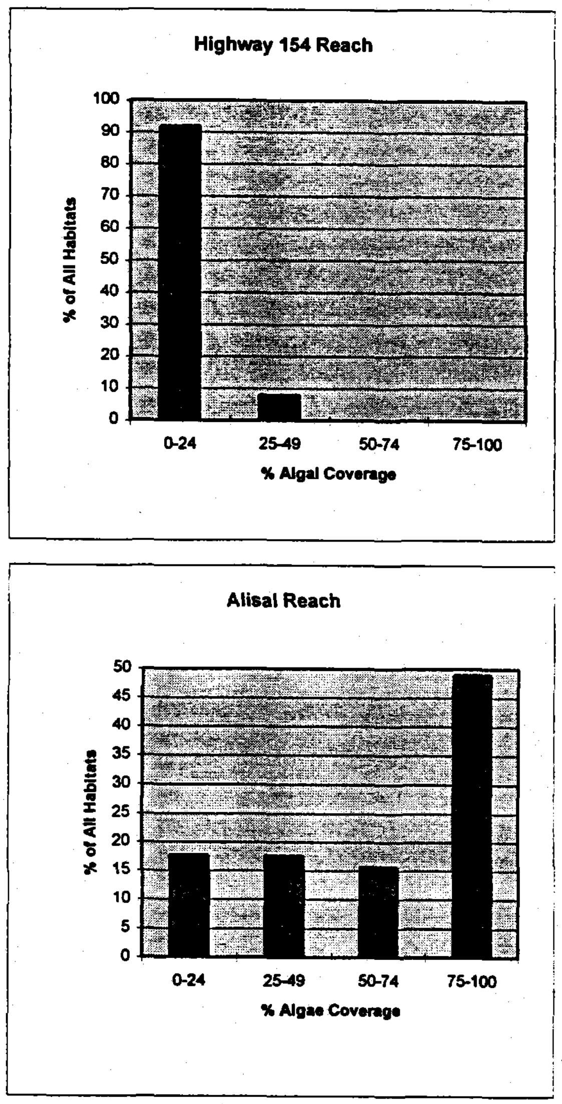


Figure 4-7. Abundance of surface algae in the mainstem Santa Ynez River, August, 1995.

Although algal mats declined or disappeared during the winter of 1995-96 it was again extensive by early summer 1996, particularly in the Refugio, Alisal, and Cargasachi reaches, but even in certain habitats in the Highway 154 reach. In the August surveys, which followed initiation of WR 89-18 releases from Bradbury Dam, algae were not observed in any of the habitats where snorkel surveys were conducted.

Substrate

Substrate can influence the abundance and distribution of fishes. Rainbow trout/steelhead require gravel and cobble free of silt and sand for spawning. Large substrate such as boulders and large cobble can provide important habitat for immature rainbow trout/steelhead during the winter. Fisheries surveys conducted by the SYRTAC indicate that sculpin tend to be more abundant in the Santa Ynez River where cobble and boulder substrate was found. This substrate type may provide them better cover and food production. Habitat surveys conducted by the SYRTAC have indicated that substrate consists primarily of cobble near Bradbury Dam but grades to greater proportions of gravel downstream (Table 4-3, Figure 4-8).

During habitat mapping surveys conducted by Entrix in the late winter and early spring of 1994 it was noted that spawning-sized gravels were of extremely limited availability within the wetted channel between Refugio Road and Bradbury Dam. It was also noted that additional gravel was available outside the wetted channel in a variety of locations. Between Refugio Road and Buellton the habitat surveys noted substantially more spawning-sized gravel. In the two-mile reach downstream of the wastewater treatment plant in Lompoc, the study found that spawning gravel was of limited availability and was judged to be highly embedded (clogged with fine sediments), severely reducing its utility. High river flows during the winter of 1994-95 may have altered substrate conditions since the Entrix study.

Passage Barriers

The Santa Ynez River between Buellton and Bradbury Dam was examined for passage barriers during the habitat surveys conducted in the late winter and early spring of 1994 by Entrix. Similar surveys were conducted by DWR and Thomas R. Payne in 1991 for the river reach between Lompoc and Buellton. No falls or velocity barriers were observed, but areas with insufficient depth for upstream migration were observed. These barriers were always related to shallow riffles or gravel bars, and not to permanent hydrological features. Entrix conducted a passage evaluation based on passage criteria developed by Thompson (1972) and concluded that a minimum flow of 25 cfs would provide sufficient depth of flow to meet passage criteria for steelhead. The USFWS has questioned the methodology used to develop this estimate since transects were not specifically selected to represent critical passage areas (Ed Ballard, pers comm, USFWS 1997).

Other Habitat Features

Habitat surveys have also recorded other potentially important features of fish habitat including, percent cover, and extent of different cover components such as large, woody debris and undercut banks. In addition, data on bank composition in terms of dominant vegetation types, percent of bank vegetated,

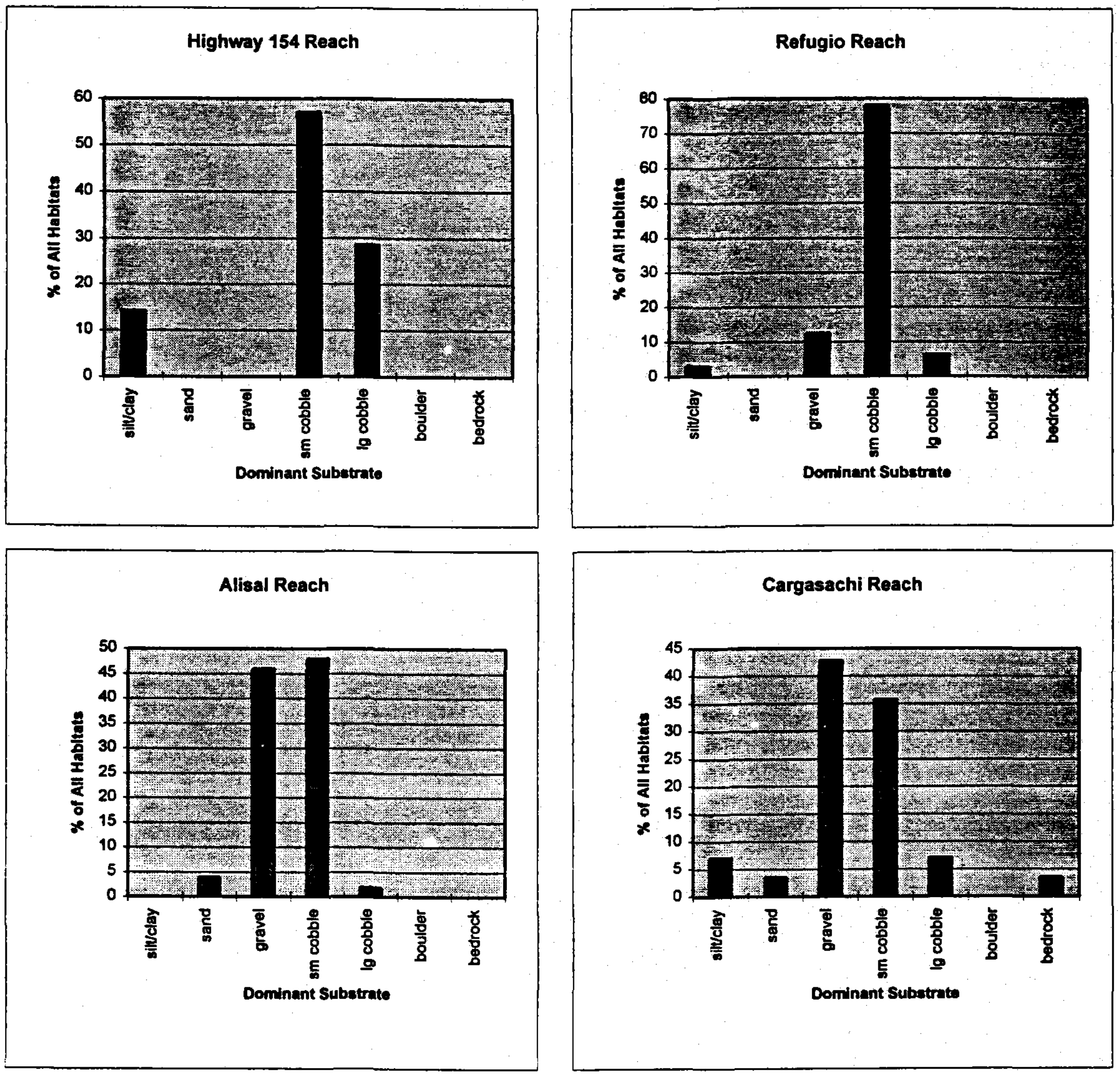


Figure 4-8. **Substrate characteristics in the Santa Ynez River mainstem, July, 1995.**

and a bank disturbance rating have been collected for all surveyed reaches. This information is part of standard habitat mapping methodologies and should provide useful information to interpret fish distribution, abundance, and habitat preferences. Evaluation of this data was not considered a priority for the present report.

4.2 Santa Ynez River Lagoon

Lagoons such as the Santa Ynez River Lagoon typically form where a river crosses a sandy beach to reach the ocean, and the ocean has enough wave energy to generate a strong littoral drift of sand along the shore, as well as seasonal onshore-offshore movement. Typically, the Santa Ynez River is "flashy": its flow responds strongly to rainstorms in the watershed, but in dry weather, there is little flow. In such a setting, high winter river flows are capable of opening an outlet, or breach, and transporting sand out of the outlet faster than the littoral drift can supply sand to it.

Low summer flows, in combination with tidal flows, however, are insufficient to keep the outlet open, and the littoral drift and onshore sand movement rebuild the beach and berm across the outlet, closing it.

When the lagoon is open and river flow is high, the currents in the lagoon may be strong enough to temporarily push virtually all the salt water out of the estuary. When the lagoon is open and flows are moderate, the lagoon may become an estuary with both freshwater and higher salinity regions. Flow at the entrance reverses cyclically, in response to the tides, although faster on the ebb than on the flood because of the fresh-water discharge. The flood tide brings ocean water into the lagoon, where it partly mixes with the fresh water, and because of its greater density tends to settle to the bottom, particularly accumulating in the deeper areas. In addition, breaking waves may wash salt water into the lagoon.

As flows decrease, the salt water tends to work its way upstream along the bottom, as in an estuary, due to density-induced currents. Consequently, after closure, a substantial amount of salt water can be trapped in the lagoon, mixed to varying degrees with the fresh water, and distributed unevenly throughout the lagoon. In a long, narrow lagoon such as the Santa Ynez Lagoon, salinity increases with depth, and generally decreases with distance from the ocean.

When the lagoon is closed, inflows to the lagoon include the low river flow and inflows from groundwater. Outflows include evaporation and seepage to groundwater (including seepage through the beach to the ocean). Under normal groundwater conditions, the water table slopes upward away from the ocean. Since the water level in the linear lagoon is essentially level, this could result in groundwater inflow near the upstream end, and outflow near the downstream end.

The lagoon is located at the mouth of the Santa Ynez River, about 9 miles WNW of the town of Lompoc, California. It extends about 13,000 ft along its axis upstream from the beach, with an average width of about 300 ft. Near the beach, it is substantially wider, and near the upstream end, narrower. The average water depth is about four feet, and the water surface elevation during the July 1994 sampling period, with the breach closed, was almost five feet above mean sea level. The volume of water stored in the closed lagoon is approximately 300 acre-feet.

Comparison of older topographic maps with recent aerial photographs (taken May 20, 1994) show that the shape of the Santa Ynez River Lagoon has changed significantly over the years. Changes in the details of the shape and location of the lagoon probably do not significantly affect either the hydrodynamic or biological processes operating there.

4.3 Tributaries

Salsipuedes and El Jaro Creeks

Reconnaissance-level walking surveys of Salsipuedes and El Jaro creeks were conducted on May 4, 1994 (SYRTAC 1994). Flow was visually estimated to be about 3 cfs and water temperature at 11:46 am was 17.0 C. The first quarter mile of Salsipuedes Creek upstream from Bridge 51-95 was characterized as having abundant riparian vegetation and an intact canopy existed in most of this area. Some small pools (< 1 m deep) were present which offered cover in the form of bubble curtains and undercut banks. The flood plain widens after the first quarter mile and there was minimal riparian vegetation and canopy to influence the creek. Several small pools were present with undercut banks and other features that may provide habitat for trout.

There was excellent cover and shading in Salsipuedes Creek from the confluence with El Jaro Creek to the end of the survey area, approximately 300 m (980 feet) upstream. In addition, suitable spawning gravels were observed in all riffle and pool tail areas. There was a recently constructed beaver dam about 100 m (330 feet) below the Jalama Road bridge. Directly below Jalama Road bridge was a large deep pool where several fish were observed (species unknown).

Temperature recorded in the area of the confluence of El Jaro and Salsipuedes creeks indicated that Salsipuedes Creek above the confluence with El Jaro Creek has water temperature 2-3 C cooler than El Jaro Creek. Water temperature below the confluence appeared to be predominantly influenced by El Jaro Creek as temperature there was only slightly cooler than El Jaro (Section 3.4). In Salsipuedes Creek, both above and below the confluence, morning and afternoon dissolved oxygen measurements were higher when compared to El Jaro Creek.

In El Jaro Creek, near the confluence with Salsipuedes Creek, there were large pools, good riparian cover with overhanging vegetation, good instream cover in the form of vegetation and boulders, and generally excellent trout habitat. Some rainbow trout/steelhead were also observed in this section. Further upstream there were areas where habitat was marginal, consisting of fine sediment, slow flow, and medium canopy. Other sections had high gradient riffles, very rocky substrate, and appeared to provide quality trout habitat. Two possible redds were seen about a mile and a half upstream of a road ford. Though some reaches upstream of the ford had excellent spawning and rearing habitat no trout were observed in the stream for two miles. Abundance of other fish (i.e., arroyo chub, stickleback) was greatly reduced when compared to below the ford. A greater influence from cattle grazing was observed further upstream in El Jaro Creek. The stream banks were destabilized and there was an increase in the amount of long silty pools.

Habitat in Salsipuedes and El Jaro creeks was mapped by Entrix in the early spring of 1994, although there have been some significant changes following high flow periods in 1995. The survey found habitat in Salsipuedes Creek was comprised primarily of shallow runs and lateral scour pools with occasional short low gradient riffles. Pools generally had a maximum depth of approximately 2.5 feet but some pools had a maximum depth of 4-6 feet or more. The survey found primarily runs and shallow pools in El Jaro Creek, with the channel being more highly confined and steeper than Salsipuedes Creek. It was estimated that El Jaro Creek contributed approximately three quarters of the flow present in Salsipuedes Creek downstream of the confluence at the time of the survey. Habitat surveys conducted by Entrix described spawning habitat as plentiful in Salsipuedes Creek and adequate in El Jaro Creek.

Habitat surveys by Entrix in the spring of 1994 located two cascades in Salsipuedes Creek approximately 4-5 feet high, both below bridge crossings. Entrix concluded that these cascades could present a hindrance to upstream migrating rainbow trout/steelhead when stream flow is low. Entrix also noted that a concrete road crossing and a cascade in El Jaro Creek pose potential migrational hindrance for rainbow trout/steelhead.

Impacts from cattle grazing have been observed in Salsipuedes and El Jaro creeks, particularly in the lower section of Salsipuedes Creek.

Nojoqui Creek

A reconnaissance-level survey was conducted on May 5, 1994 by SYRTAC (1994). Flow was visually estimated between 3 and 4 cfs and water temperature was 16.5 C at 10:12 AM. The survey began at Highway 101 at the third bridge crossing the creek south of Buellton. The area upstream of the bridge was characterized as having dense riparian vegetation and canopy along both banks which hung into and over the creek in many places. Walking along and through the stream proved difficult due to abundant vegetation. Spawning and rearing habitat appeared to be in good condition along the upper survey reach although spawning gravels were embedded in some areas. Several medium to large pools appeared to have sufficient cover and depth to hide fish from observation. These pools were snorkeled during 1994 but no rainbow trout/steelhead observed. Approximately one quarter mile upstream from the bridge, overgrowth of streamside vegetation made passage increasingly difficult.

The area downstream of the bridge was characterized as having good spawning and rearing habitat. Dense riparian and overhanging vegetation provided canopy cover for much of the stream. Many pools were available that offered excellent cover in the form of depth, roots, undercut banks, and boulders. Abundant populations of arroyo chub and stickleback were observed throughout much of the stream habitat. Just past the second to last northern most Highway 101 bridge that spans the creek was a concrete dam that held the water flow approximately one meter above a plunge pool (this dam washed out in 1995). There was a huge root mass on the bank and although no fish were observed the pool appeared to provide excellent over-summering habitat for rainbow trout/steelhead.

Downstream from the dam, land use impacts became much more evident (SYRTAC 1994). Stream banks were noticeably eroded. Cattle tracks were present in the stream and green algae was becoming abundant, covering as much as 75 percent of pool surfaces. Sunfish and largemouth bass were observed in one deep pool. The stream bed and stream bank continued to become more degraded closer to the confluence with the Santa Ynez River and about one-half to three-quarters of a mile before the confluence there was no canopy, very little riparian vegetation, and the flow began to disappear. Some of this section had been channelized with a bulldozer. The streambed was dry within a quarter mile of the Santa Ynez River. No trout were observed during the survey. In spite of dry conditions near the mouth, Nojoqui Creek was judged to have some of the better spawning and rearing habitat encountered during the 1994 stream surveys conducted by SYRTAC (1994).

In early spring 1994, Entrix conducted a more detailed habitat inventory and found habitat in Nojoqui Creek to consist primarily of shallow runs and pools, with most pools having a maximum depth of approximately 1-2 feet though a smaller number of pools had maximum depths ranging from 3-6 feet. Streamflow was low at the time of the survey with the lower one half mile of creek dry. No significant passage barriers were found by Entrix in Nojoqui Creek.

Alisal Creek

Habitat in Alisal Creek has not been surveyed by the SYRTAC. Entrix did not survey the creek either, presumably due to the migration barrier at its mouth. Entrix reported that a concrete structure in Alisal Creek, just upstream of where it joins the Santa Ynez, was an apparent migration barrier for fish. The structure consisted of a 5 foot high wall below a 54 foot long concrete apron. This structure was washed out during high flows in January 1995 and passage into Alisal Creek is currently unimpeded.

Quiota Creek

On May 5, 1994 aquatic habitat was described on a reconnaissance-level walking survey of Quiota Creek by SYRTAC (1994). The survey began 1.2 miles upstream of the Refugio Road bridge at the first road crossing south of the Santa Ynez River. At 2:00 pm, water temperature was 17.0 C. Water clarity was poor in all pools surveyed due to a cloudy precipitate in the water. No fish were observed in any portion of the stream. Several insect populations appeared to be abundant and comparable to other tributaries including several species of *Tricoptera* (caddisfly) and *Ephemeroptera* (mayfly). In addition, *Belostomatids* (toe biters) were also observed.

Aquatic habitat in Quiota Creek was found to be degraded from land use activities. Cattle fecal matter was visible in the stream and on rocks. Canopy consisted of oaks and willows that were fairly abundant throughout the tributary although streamside vegetation was lacking in many places. Silt was the dominant or subdominant substrate in all areas that had water, especially pools.

Entrix conducted a habitat inventory in the lower one mile of Quiota Creek in early spring 1994 with a streamflow estimated at 3 cfs and concluded that the reach surveyed would not support spawning or rearing of rainbow trout/steelhead (trout were seen spawning in this area in 1995, see Section 5.3). Upstream and tributary areas have not been surveyed but in one tributary, where electrofishing was conducted in August 1994, it was noted that boulder cover and adequate pool depth in some places provided potential refuge for trout and that canopy in the form of large oaks and cottonwoods shade a significant portion of the creek. The presence of rainbow trout/steelhead in this area was confirmed in the electrofishing survey (Section 5.3).

Hilton Creek

Entrix surveyed the lower quarter mile of Hilton Creek and found it to consist of primarily bedrock chutes and plunge pools averaging 3 feet in maximum depth, with adequate spawning habitat at the tails of the pools. Entrix found the channel in this portion of Hilton Creek to be high gradient and steeply confined, with at least one of the bedrock chutes being a possible barrier to migrating rainbow trout/steelhead under streamflow conditions at the time of survey (estimated by Entrix at 0.5 cfs upstream with no flow at the mouth). Hilton Creek was reported by Entrix to have good clarity even after several days of rain and concluded that channel disturbance and water quality problems appear minimal in Hilton Creek.

The SYRTAC surveyed the lower 1000 feet of Hilton Creek in 1995. The survey classified 44% of the stream as run habitat, 27% as riffle, 26% as pool, and 3% as cascade. Mean width was 9.3 feet.

4.4 Summary

- Fish habitat in the Santa Ynez River mainstem has been surveyed extensively in the section between the Highway 154 bridge (mile 3.4) and the Highway 101 bridge in Buellton (mile 13.6). In addition, a quarter mile section directly downstream of Bradbury Dam and a 1.5 mile section near Lompoc have also been surveyed. Mesohabitat characteristics (pool, riffle, run) have been adequately described in that section of the river. Habitat conditions in other sections of the mainstem have not been documented. The level of detail and area of coverage for habitat surveys in the tributaries have been significantly less than that in the mainstem.

- The mainstem, in surveyed reaches, has been dominated by pool habitat during surveys conducted to date. Riffle and run habitat is very limited at most times though it increases during WR 89-18 releases. Pool habitat exists even at low flow, but utility of pool habitats may be limited for rainbow trout/steelhead by elevated summer water temperature and low dissolved oxygen levels (Section 3).

- Riparian vegetation is poorly developed in the mainstem and in most areas does not provide significant shade. Riparian vegetation in the tributaries has not been surveyed at a sufficient level of detail to compare to the mainstem, however observations indicate portions of some tributaries are well shaded.

- Instream vegetation in the mainstem in the form of algal mats can be extensive during summer months. Algae is not usually extensive in the reach immediately downstream of Bradbury Dam (except in some pools), but can dominate the aquatic habitat in the Refugio and Alisal reaches during summer low flow conditions. WR 89-18 releases appeared to reduce or eliminate algal mats.

- Pools, particularly deep pools, provide habitat for juvenile and older age classes of rainbow trout/steelhead, and all age classes of largemouth bass and sunfish. During low flow conditions these may be the only aquatic habitat available. Pools in the lower reaches can be thermally stratified during periods when there is little or no flow with relatively cool water at the bottom of deeper pools (thermal stratification can occur in pools as shallow as 3-4 feet). Pools in the Highway 154, Refugio, and Alisal reaches (up to 9.5 miles downstream of Bradbury Dam) held trout greater than 6 inches in length throughout the summers of 1995 and 1996 under conditions of little or no surface streamflow. There is some uncertainty about the distribution of pool habitat since surveys conducted in 1994 and 1995 gave different results, possibly due to differences in reaches surveyed, changes due to high flows in the intervening winter, or both.

- Substrate in the form of gravel of suitable size for spawning rainbow trout/steelhead is found in all the surveyed reaches but its utility is dependent on the volume of streamflow. Quality of spawning gravel in the Lompoc reach was poor due to accumulations of fine sediments. The areal extent of spawning gravel in the mainstem has not been quantified. Entrix (1995) has attempted to assess the relationship of river flow to the availability of spawning habitat for rainbow trout/steelhead using the IFIM methodology. A discussion of that analysis is presented in the Cachuma Contract Renewal Fish Resources Technical Report (Entrix, 1995).

- The only passage barriers found in the mainstem were due to shallow conditions during low flows, and some beaver dams at low to moderate flows. Alisal Creek has been blocked just upstream of the mouth by a concrete structure, which subsequently washed away during January, 1995. Two cascades below bridges in Salsipuedes Creek may hinder migration of rainbow trout/steelhead at lower flows, particularly smaller resident fish, but were not judged to be insurmountable barriers by Entrix and SYRTAC biologists. No other passage barriers have been reported though much of the tributary reaches have not been extensively surveyed.

5.0 FISHERY RESOURCES

The SYRTAC has conducted four types of fisheries monitoring studies since 1993. Snorkel surveys and electrofishing surveys have been conducted in the mainstem and tributaries, usually in conjunction with habitat surveys (Table 5-1, Figure 4-1). Trapping of upstream and downstream migrating rainbow trout/steelhead has been conducted primarily at the mouths of tributaries (Table 5-1, Figure 5-1). Objectives of the fisheries monitoring are to (1) document the distribution and relative abundance of rainbow trout/steelhead and other fish species within the Santa Ynez River and its tributaries below Bradbury Dam, (2) document and quantify the seasonal timing and numbers of adult rainbow trout/steelhead migrating into tributaries of the Santa Ynez River, and (3) document the movement of juvenile rainbow trout/steelhead and steelhead smolts from tributaries into the Santa Ynez River.

The fisheries surveys have been mostly qualitative in nature and therefore do not allow for estimates of actual numbers of individuals present. They do indicate presence or absence of different species and give a general idea of the relative abundance at different times and locations. Visual surveys, such as snorkel surveys, may be biased since the ability to see fish depends on several environmental factors including water clarity, light intensity, and amount of cover available. Fish behavior is also an important factor. Some species are more likely to select habitats where they are more difficult to see than other species. Different life-stages of the same species also select different habitats and differ in their susceptibility to observation. Trapping can be problematic because high flows can wash away or damage traps or allow fish to pass undetected. Rainbow trout/steelhead generally migrate during periods of increased streamflows. If these sources of potential bias are considered in interpreting data, useful information can still be developed from the fishery surveys performed to date.

5.1 Mainstem

Fish populations of the lower Santa Ynez River and its tributaries are composed of both native and introduced exotic species (Table 5-2). All of the species native to the river reported in the 1940s are still present (Entrix, 1995). Native species include Pacific lamprey, threespine stickleback, rainbow trout/steelhead, and sculpin. In addition, several introduced species have established reproducing populations in Lake Cachuma and the Santa Ynez River. These include largemouth bass, green sunfish, arroyo chub, channel catfish, and mosquitofish. Still other species have become established in Lake Cachuma and individuals may enter the Lower Santa Ynez River in releases from Bradbury Dam but do not establish reproducing populations in the river. This group includes black bullhead, black crappie, smallmouth bass, carp, and goldfish. The presence of reproducing populations is established by observation of adults exhibiting spawning behavior, the presence of nests, and the presence of recently hatched immature fish (fry or young-of-year). Healthy, self-sustaining populations will exhibit all of these features as well as an abundance of individuals representing a full range of age classes.

The SYRTAC first conducted electrofishing and snorkel surveys in the reach between Highway 154 and Bradbury Dam in 1993 (Tables 5-3 and 5-4). Twelve species of fish were collected or observed, including small numbers of rainbow trout/steelhead. Details of these surveys and the exact locations of study sites are described by Entrix (1995).

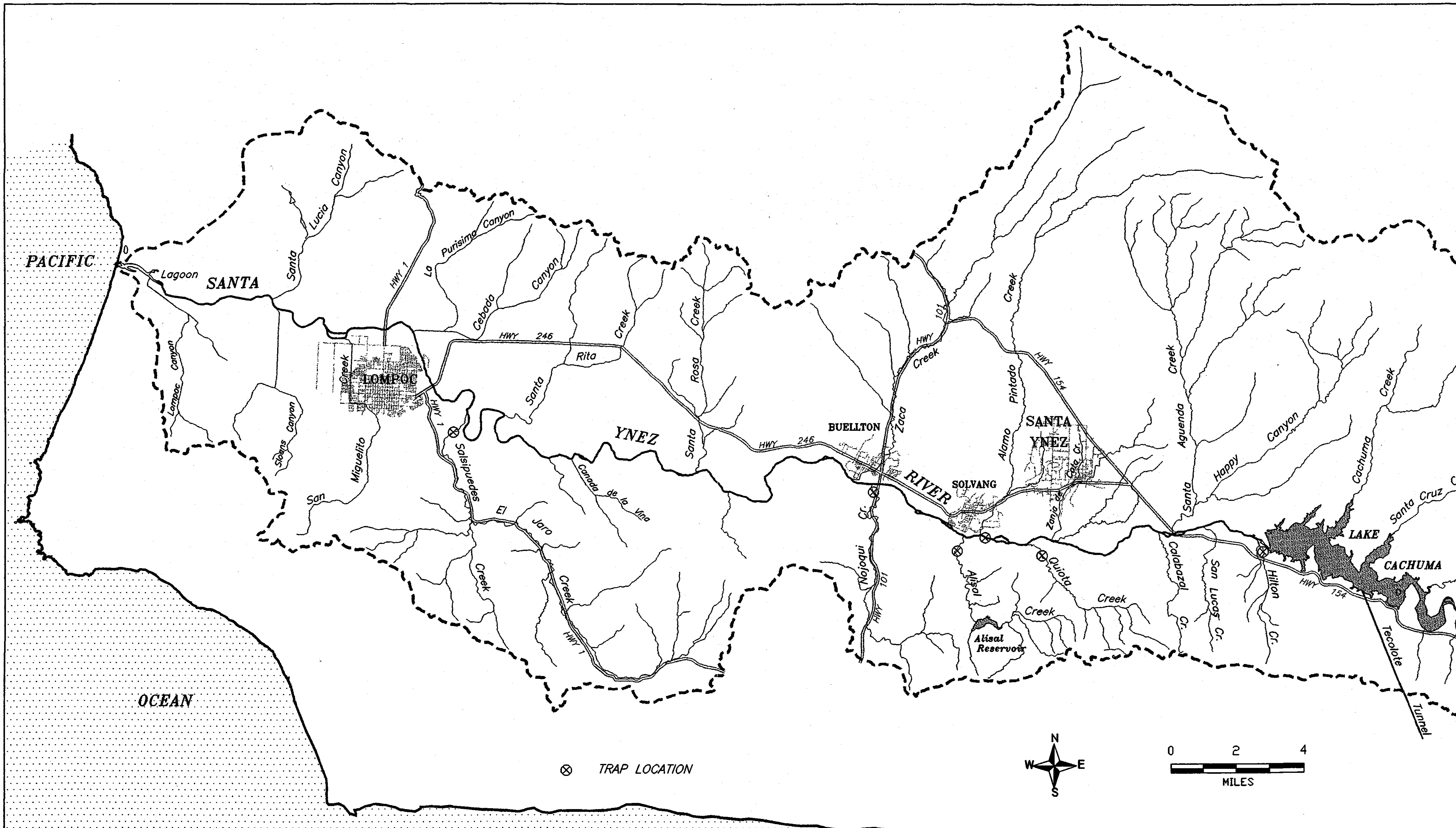


Figure 4-1.
Location of Fish Migrant Traps
On the Mainstem of Santa Ynez
River and Tributaries

Table 5-1. **Study design/sampling schedule for fishery surveys**

SNORKEL SURVEYS-Highway 154 reach, Mile 0.5 to 0.25		
	Date	Survey Description
1995	Aug 22	Survey of 3 pool and 5 run habitats
	Sept 23	Same
	Oct 19	Same
1996	May 21	Survey of 3 pool, 2 run, and 3 riffle habitats
	June 20	Same
	Aug 17	Same
SNORKEL SURVEY-Refugio reach, Mile 7.8 to 3.4		
	Date	Survey Description
1995	Aug 17	Survey of 7 pools and 3 run habitats
	Sept 20	Same
	Oct 16	Same
	Nov 21	Same
	Dec 20	Same
1996	Jan 23	Same
	June 19	Same
	July 24	Same
	Aug 19	Same
SNORKEL SURVEY-Alisal Road, Mile 9.5 to 7.8		
	Date	Survey Description
1995	Aug 4	Survey of 7 pool and 2 run habitats
	Sept 14	Same
	Oct 6	Same
	Nov 14	Same
	Dec 27	Same
1996	Jan 17	Same
	May 15	Same
	June 18	Same
	July 26	Same
	Aug 13	Same

Table 5-1. **Study design/sampling schedule for fishery surveys (continued).**

SNORKEL SURVEY-Cargasachi reach, Mile 24 to 22		
1995	Date	Survey Description
	Aug 8	Survey of 1 pool and 5 run habitats
	Sept 14	Same
	Oct 6	Same
	Nov 14	Same
1996	Dec 27	Same
	Jan 26	Same
	June 21	Same
	July 29	Same

UPSTREAM MIGRANT TRAPPING					
Year	Location	Beginning Date	End Date	Trapping Period (Days)	Functional Trap Days
1994	Hilton	1/19/94	4/21/94	92	NA
1994	Salsipuedes	3/3/94	4/21/94	49	44
1995	Hilton	1/16	5/19	124	103
1995	Salsipuedes	10/20/94	6/22	183	108
1995	Alisal	1/18	2/7	19	4
1995	Quiota	2/2	2/22	21	2
1995	Nojoqui	2/25	4/24	88	33
1996	Hilton	2/23	2/25	3	3
1996	Salsipuedes	2/9	7/1	170	160
1996	Mainstem Mile 8.7	2/9	5/1	146	139

Table 5-1. **Study design/sampling schedule for fishery surveys (continued).**

DOWNSTREAM MIGRANT TRAPPING					
Year	Location	Beginning Date	End Date	Trapping Date (Days)	Functional Trap Days
1994	Mainstem Alisal Golf Course	5/22	6/10	19	19
1994	Salsipuedes	4/6	7/1	86	86
1995	Hilton	3/15	6/21	98	93
1995	Salsipuedes	10/20	6/22	183	108
1995	Nojoqui	3/29	4/24	26	26
1996	Salsipuedes	1/4	7/1	176	166
1996	Mainstem Mile 8.7	1/4	5/1	146	139

ELECTROFISHING SURVEYS		
Date	Location	Survey Description
8/31/95	Alisal Unit # 25, 28, 45 & Refugio Unit # 17	Verification of lengths of species observed during snorkel surveys
9/1/95	Highway 154 reach - all habitats upstream of Long Pool	Same
9/5/95	Cargasachi reach units # 1,3,5,7,16-18,29 and a few additional units between	Same
10/19/95	Highway 154 - all units upstream of Long Pool same units in Alisal and Refugio reaches as previous	Same
Tributaries		
March 1987	Salsipuedes & El Jaro Creeks	Qualitative Electrofishing
March 1988	Salsipuedes & El Jaro Creeks	Qualitative Electrofishing
July 1993	El Jaro Creek	Qualitative Electrofishing
May 1994	Salsipuedes & El Jaro Creeks	Qualitative Electrofishing
August 1994	Salsipuedes & El Jaro Creeks	Qualitative Electrofishing
August 1994	Tributary to Quiota Creek	Qualitative Electrofishing
February 1995	Alisal Creek upstream of Impoundment	Qualitative Electrofishing

TABLE 5-2 Distribution of fish species regularly observed in the Santa Ynez River downstream of Bradbury Dam.

Fish Species	Mainstem				Tributaries					
	Hwy. 154 reach	Refugio reach	Alisal reach	Cargasachi reach	Hilton Creek	Quiota Creek	Alisal Creek	Nojoqui Creek	Salsipuedes Creek	El Jaro Creek
Native Species										
Pacific Lamprey Adults	P		P							
Pacific Lamprey Amoecetes			P				P			
Steelhead/Rainbow Trout Adults	P		P		P	P	P		P	P
Steelhead/Rainbow Trout Evidence of Spawning					P	P			P	P
Steelhead/Rainbow Trout Young-of-Year	P				P		P		P	P
Steelhead/Rainbow Trout Juvenile	P	P	P			P	P		P	P
Threespine Stickleback	U	N	N	P				P	P	
Prickly Sculpin	N	N	P	U					P	
Introduced Species										
Arroyo Chub	U	N	P	P				P	P	
Smallmouth Bass	P									
Largemouth Bass Adults	N	P	N	P						
Largemouth Bass Juveniles	N	N	N	N				P		
Largemouth Bass Young-of-Year	P	P	N	N						

Notes:
N=Numerous: frequently seen, abundant
U=Uncommon: seen infrequently, low abundance
P=Present: seen occasionally, surveys not sufficient to determine abundance

Table 5-3. Results of the SYRTAC electrofishing survey at streamflow releases of 10, 5 and 1 cfs in the Santa Ynez River Downstream of Bradbury Dam, 1993.

	Site	Sculpin			Arroyo chub			Stickleback			Smallmouth bass			Green sunfish			Bullhead			Lamprey		
	Number	0 cfs	5 cfs	1 cfs	10 cf	5 cfs	1 cfs	10 cf	5 cfs	1 cfs	10 cf	5 cfs	1 cfs	10 cf	5 cfs	1 cfs	10 cf	5 cfs	1 cfs	10 cf	5 cfs	1 cfs
Segment 1	1	409	297	608	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	57	179	1,108	0	3	3	0	0	0	0	0	4	0	0	1	0	0	0	0	0	0
	3	476	190	423	0	0	0	0	4	0	0	1	1	0	0	0	0	0	0	0	0	0
	4	2	12	72	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	944	678	2,211	0	3	3	0	4	0	0	1	5	0	0	1	0	0	0	0	0	0
Segment 2	5	522	737	437	0	0	0	0	0	0	0	2	1	0	0	1	0	0	0	0	0	0
	6	40	264	286	0	0	0	0	0	0	1	0	4	0	0	1	0	0	1	0	0	0
	Total	562	1,001	723	0	0	0	0	0	0	1	2	5	0	0	2	0	0	1	0	0	0
Segment 3	7	44	13	12	61	0	0	4	43	93	0	0	0	0	0	0	0	0	0	0	0	0
	8	6	3	5	8	11	7	10	25	55	0	0	0	0	0	0	0	0	42	0	0	0
	9	4	N/S	2	0	N/S	1	10	N/S	41	0	N/S	0	0	N/S	0	0	N/S	0	0	N/S	0
	10	N/S	4	4	N/S	102	0	N/S	120	48	N/S	0	0	N/S	0	0	N/S	0	0	N/S	0	0
	11	2	1	0	1	0	0	2	5	16	0	0	0	0	0	0	0	0	0	0	0	0
	12	46	8	32	5	1	0	2	2	6	0	0	0	0	0	0	0	0	0	0	0	0
	13	6	18	13	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	1
	Total	108	47	68	75	114	8	28	198	262	0	0	0	0	0	0	0	0	42	0	0	1
Segment 4	14	153	194	121	41	9	9	12	12	85	0	0	0	0	0	0	0	0	0	0	0	0
	15	N/S	45	4	N/S	2	2	N/S	25	6	N/S	0	0	N/S	0	0	N/S	0	0	N/S	0	0
	Total	153	239	125	41	11	11	12	37	91	0	0	0	0	0	0	0	0	0	0	0	0

Table 5-4. Snorkel Survey Observations (visual estimates) in Study reach Pools, Santa Ynez River, 14 October and 10 November 1993.

	Rainbow Trout		Black Bass		Sunfish		Sculpin		Arroyo Chub		Stickleback		Catfish	
	Oct	Nov	Oct	Nov	Oct	Nov	Oct	Nov	Oct	Nov	Oct	Nov	Oct	Nov
Stilling Basin[a]	0	0	30	4	10	0	0	0	0	0	0	0	2	0
Site 2	0	0	0	0	0	0	5	2,000[b]	0	0	0	0	0	0
Site 4[a]	4	4	12	0	0	0	0	0	0	0	0	0	0	0
Site A	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Site B	0	0	0	8	0	0	0	15	5	0	5	0	0	0
Site C	3	0	40	35	50	50	0	25	20	0	20	50	0	0
Site D[a]	0	0	9	10	0	15	5	0	10	0	10	0	31	0
Site E	0	0	0	4	0	1	0	0	200[b]	50	30	500[b]	0	100[b]
Site 8	0	0	0	3	0	0	0	5	500[b]	3,000[b]	100[b]	3,000[b]	0	0
Site F	0	0	0	0	0	0	0	10	1	75	50	200[b]	0	0
Site 9	0	0	0	0	0	0	0	0	500[b]	0	150[b]	1,000[b]	0	0
Site 14[b]	1	N/S[c]	20	N/S	50	N/S	100	N/S	50	N/S	100[b]	N/S	0	N/S

[a]Poor visibility limited accuracy of snorkel surveys.

[b]Species was extremely abundant and/or cover was to thick to accurately count all fish. Numbers presented represent a visual assessment as opposed to a count.

[c]N/S - Station not sampled during November survey

Routine snorkel surveys in 1995 and 1996 provide the primary source of information on fish distribution and abundance. Snorkel surveys were conducted at roughly monthly intervals in the mainstem Santa Ynez River and on a few occasions in some of the tributaries (Table 5-1, Figure 4-1). Electrofishing surveys were also conducted in each of the survey reaches. Electrofishing surveys were used primarily to collect fish, particularly rainbow trout/steelhead, for measurement of length and weight and to collect scale and tissue samples for genetic analysis. Electrofishing surveys provided additional information on species composition and fish distribution.

Arroyo Chub

Arroyo chub is an introduced species in the Santa Ynez River but is native to coastal streams of Southern California (Moyle, *et al.*, 1989). It is well adapted to intermittent streams and feeds on aquatic vegetation and associated invertebrates.

Arroyo chub were observed in a pool in the Santa Ynez River that had a pre-dawn dissolved oxygen concentration of approximately 1.6 mg/l (SYRTAC, 1994). In electrofishing and snorkel data collected in 1993 the SYRTAC found Arroyo chub were abundant in shallow pools, and relatively scarce in riffle and run habitats. However, they were not observed in pools inhabited by large predators (bass and sunfish). Although the Arroyo chub seems to prefer very low water velocities, they are adapted to the relatively high winter flows common in streams in their native range.

In snorkel surveys conducted by the SYRTAC in 1995 and 1996, abundance of Arroyo chub has generally been greatest in the Refugio reach with the greatest numbers usually observed in pool habitats, although they were predominantly in runs in the Cargasachi reach where few pools exist. Table 5-5 indicates numbers of Arroyo chub observed in each sample unit for all survey dates. (Stippled areas indicate no survey during the period, blank cells indicate no observation of the species during as survey.) Blanks in this and the following fish distribution tables indicate that no fish were observed, while shaded areas indicate that no survey was performed. Chub were most abundant in the Refugio reach, the reach having the most extensive growths of algae. Chub were moderately abundant in the Alisal reach but few chub have been seen in the Highway 154 reach. Chub numbers appeared to decline slightly from the late fall of 1995 through the spring and early summer of 1996, particularly in the Alisal reach where they virtually disappeared by November of 1995. In the Cargasachi reach, chub have not been abundant and they also disappeared from the reach by fall of 1995 and have not been seen there in surveys through 1996. In the Refugio reach numbers remained fairly high until August 1996 when numbers dropped substantially. This decline in abundance followed initiation of WR 89-18 flow releases from Cachuma Reservoir (in mid-July), a substantial increase in the number of largemouth bass observed in the reach, and the disappearance of the extensive algal mats that had become established in the river.

Stickleback

Threespine stickleback are a native species with wide distribution in California. They are a small (adults 3 inches or less), short-lived species that generally reach greatest abundance during the summer months. Stickleback are repeat spawners during the breeding season and populations can expand rapidly under good conditions (Wang, 1986). They reach maturity in one year and some individuals can live 2-3 years (Moyle 1976). Stickleback can tolerate a wide range of environmental conditions including low dissolved oxygen, fluctuating temperatures, and variable

Table 5-5. Distribution of Arroyo Chub in 1995-96 Visual Surveys (PV = Poor Visibility, no survey; nr = not recorded).

Reach	Unit #	Habitat Type	Number of Arroyo Chub Observed in Snorkel Surveys.												
			Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96	Jun 96	Jul 96	Aug 96
Hwy 154	12	run	nr		nr										
Hwy 154	10	run													
Hwy 154	9	lgr		nr								nr	nr		
Hwy 154	8	run													
Hwy 154	7	pool													
Hwy 154	6	pool													
Hwy 154	5	run													
Hwy 154	2	run	1												
Hwy 154	1	pool													
Refugio	x	pool	100	200	150	400	150	300					PV		
Refugio	30	run	1000	400	800	100	400	1000					PV	130	300
Refugio	24	pool	1000	800	75	400							PV	300	100
Refugio	17	pool			175								PV	500	1
Refugio	14	pool	1000	520	1000	100	400	1000					PV	500	2
Refugio	13	run	100	100	nr	100	200	2					PV	70	
Refugio	7	pool	300	100	500	100	400	1000					PV	58	
Refugio	4	pool	1000	300	250	300	400	1000					PV		
Refugio	2	pool	350	285	250	100	200						PV	15	
Refugio	1	run	300	350	45		15	1					PV	8	
Alisal	6	pool	10	1									PV		
Alisal	8	run											PV		
Alisal	9	pool											PV		
Alisal	20	pool	70	30	50									PV	
Alisal	26	run		nr											
Alisal	28	pool	6	20											
Alisal	33	run	55	nr								PV	PV		
Alisal	37	pool	130	nr	28	1						PV	PV		
Alisal	45	pool	20									PV	PV		
Alisal	48	pool	20	12	42							PV	PV		
Cargasachi	29	run													
Cargasachi	16	pl/run													
Cargasachi	7	run													
Cargasachi	5	run	1	16											
Cargasachi	3	run	52				1	4							
Cargasachi	1	run	23	3	1										

salinity. Some populations are anadromous, spending most of their adult life in saltwater. Other populations complete their life cycle in freshwater. Three long spines in the dorsal fin on the fishes back may provide some degree of protection from predation.

In snorkel surveys during 1995 and 1996, stickleback distribution was similar to that of Arroyo chub (Table 5-6): virtually absent in the Highway 154 reach, abundant in the Refugio reach, moderately abundant in the Alisal reach, and present in low numbers in the Cargasachi reach. Like arroyo chub, the majority of stickleback were found in pools in the Refugio and Alisal reaches, the two reaches with most abundant growths of algae. Stickleback were more abundant in runs than pools in the Cargasachi reach, particularly in August. Also like arroyo chub, stickleback declined in the Alisal and Cargasachi reaches beginning in the fall of 1995 but they did not altogether disappear from these areas. Stickleback were very rare in the Cargasachi reach by June 1996 and declined substantially in the Refugio reach between July and August 1996. Declines in the Refugio reach were associated with an increase in observations of largemouth bass, particularly bass greater than six inches in length. Bass observations may have increased due to an increase in abundance or due to the fact that they were more easily seen without all the algae. The decline also followed loss of extensive algal mats that had developed in many habitats and the initiation of WR 89-18 flow releases from Cachuma Reservoir. It is possible that the WR 89-18 releases made conditions less suitable for algal growth and the algae either died back or drifted downstream. Declines in stickleback and arroyo chub may have been due to conversion of their habitats to more swiftly flowing conditions but it is more likely that the loss of algae made them more vulnerable to predation (which may have been more intense if bass abundance actually increased), and reduced their food supply. It is also possible that these species actually declined prior to the WR 89-18 releases due to habitat degradation during the low flow period.

Bass

Both largemouth and smallmouth bass have been observed in the lower Santa Ynez River. Largemouth bass are a relatively long-lived, warm-water species that becomes predaceous on other fish early in its life. Largemouth bass are restricted to habitats with little flow such as lakes, ponds, and backwater areas of larger rivers. Largemouth bass prefer warmer water temperatures and can survive at relatively low dissolved oxygen conditions (Stuber, 1982). Largemouth bass have established reproducing populations in Lake Cachuma and have likely entered the lower Santa Ynez River in reservoir releases. Bass of various age classes, including young-of-year, have been regularly and widely observed in the river since surveys were initiated in 1994.

Smallmouth bass are also relatively long-lived and predatory on other fishes. Smallmouth bass are adapted to colder temperatures than largemouth bass and inhabit flowing waters in rivers and streams in addition to lakes (Edwards *et al.,* 1983). Smallmouth bass have been seen in the lower Santa Ynez River immediately below Bradbury Dam. Smallmouth bass nests and eggs (with males guarding the nests) were observed in the tail of the spill basin and in the confluence pool (Habitat Unit 7) in the Highway 154 reach. Smallmouth bass nests have also been observed in the Long Pool in 1995 and 1996.

Largemouth bass were abundant at several sites between Bradbury Dam and Highway 154 during snorkel surveys conducted in 1993 (Entrix, 1995). Largemouth bass were moderately abundant in the Highway 154 reach during both the 1995 and 1996 surveys. Bass populations were

Table 5-6. Distribution of Threespine Stickleback in 1995-96 Visual Surveys (PV = Poor Visibility, no survey; nr = not recorded).

Reach	Unit #	Habitat Type	Number of Stickleback Observed in Snorkel Surveys.												
			Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96	Jun 96	Jul 96	Aug 96
Hwy 154	12	run	nr		nr										
Hwy 154	10	run													
Hwy 154	9	lgr											nr		
Hwy 154	8	run										nr			
Hwy 154	7	pool		3											
Hwy 154	6	pool	1												
Hwy 154	5	run													
Hwy 154	2	run													
Hwy 154	1	pool													
Refugio	x	pool	200	125	100	100	60	100					PV	0	
Refugio	30	run	1000	400	800	400	500	1000					PV	100	300
Refugio	24	pool	2000	2000	500	200	300	1000					PV	1000	83
Refugio	17	pool	400	500	350	55	70	150					PV	275	66
Refugio	14	pool	1000	2000	1000	1000	2000	1000					PV	500	83
Refugio	13	run	300	1000	NR	1000	200	1000					PV	250	40
Refugio	7	pool	1000	1000	300	100	400	400					PV	300	6
Refugio	4	pool	1000	250	150	100	150	300					PV	120	4
Refugio	2	pool	350	150	100	150	200	20					PV	112	
Refugio	1	run	300	175	50	4	100	300					PV	50	7
Alisal	6	pool	100	60			14					1000	PV	120	1
Alisal	8	run	100	1	2							12	PV	100	8
Alisal	9	pool	100	3								2	PV		
Alisal	20	pool	1000	1000	1000	200	pv	pv				1000	400	PV	
Alisal	26	run	100	nr											
Alisal	28	pool	1000	800	1000	30		6							
Alisal	33	run	300	nr	1000	15	2	60				PV	PV		
Alisal	37	pool	300	nr	1000	800	8					PV	PV	15	
Alisal	45	pool	350	1000			3					PV	PV	1	
Alisal	48	pool	1200	1000	300	30	12	15				PV	PV		
Cargasachi	29	run	60				1	6					1		
Cargasachi	16	pl/run	30	1	200	55	5	7							
Cargasachi	7	run	13		1	1	2	4							
Cargasachi	5	run	17	5			3								
Cargasachi	3	run	10			1	17	11							
Cargasachi	1	run	11					9							

dominated by fish greater than 12 inches in length and young-of-year fish (0-3 inches in length) (Tables 5-7 and 5-8). The greatest number of observations of larger size classes of largemouth bass was in pools in the Highway 154 reach, primarily in the long pool and spill basin. Conversely, young-of-year and juvenile bass were more abundant downstream in the Alisal and Cargasachi reaches. Cannibalism could be high in the 154 reach or warmer temperatures downstream may favor reproductive success there.

Few largemouth bass of any age classes were observed in the Refugio reach from the initial surveys in August 1995 through July of 1996. Between the July and August 1996 surveys, coincident with WR 89-18 releases, observations of largemouth bass of all ages increased significantly in the Refugio reach. This may have been the result of an actual increase in abundance or merely due to the fact that they became more visible since growths of aquatic algae also diminished during this period.

In the Alisal reach largemouth bass appeared to be only moderately abundant in August 1995 but they appeared to increase into October (particularly for fish in the 0-3 and 3-6 inch size classes). Again this could have been related either to change in visibility or change in actual abundance. Counts fluctuated but remained fairly high through the winter and early summer of 1996. Abundance appeared to increase greatly between the July and August 1996 surveys.

At the start of WR 89-18 releases on July 28, 1994 a downstream migrant trap was deployed in the Santa Ynez River to document downstream migration of fish species from the spill basin and long pool during the WR 89-18 releases (SYRTAC 1995). The trap was located at the boundary of the Gainey Winery and Juan Lolita Ranch (approximately 5 miles downstream from the spill basin). For several weeks prior to the releases, the entire 5 mile reach from the trap location to the long pool was almost completely dry. Only a few shallow pockets of water were present. It took three days for the water (releases at 150 cfs) to reach the trap site.

The majority of fish migration was observed within the first week of releases. Hundreds of fish (all warm water species, mainly juvenile largemouth and smallmouth bass) were visually observed following the leading edge of water as it progressed downstream (SYRTAC 1995). The trap was not deployed until one day after the leading edge of flow had passed. As a result, the capture results do not reflect the numbers of fish visually observed at the leading edge of the flows. A total of ten largemouth bass were captured ranging in size between 60-89 mm (2.4 to 3.5 inches). About 70 percent of the bass were captured within the first week of trapping.

Sculpin

Although there are several species of freshwater sculpin in California, only the prickly sculpin is known to occur in the Santa Ynez River. Two other coastal species, the coastrange and riffle sculpin, are not found south of Morro Bay. Sculpin are tolerant of a wide range of environmental conditions. They inhabit small, cold streams in the Sierra foothills as well as turbid sloughs in the Sacramento-San Joaquin Delta. Prickly sculpin mature in their second, third or fourth year. They inhabit the bottom and are often hidden in the substrate, particularly during the day (Moyle, 1976).

Table 5-7. Distribution of Largemouth Bass Larger Than 6 Inches in 1995-96 Visual Surveys (PV = Poor Visibility, no survey; nr = not recorded)

Reach	Unit #	Habitat Type	Number of Largemouth Bass greater than 6 Inches Observed In Snorkel Surveys.												
			Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96	Jun 96	Jul 96	Aug 96
Hwy 154	12	run	nr		nr										
Hwy 154	10	run													
Hwy 154	9	lgr		ns								nr	nr		
Hwy 154	8	run													
Hwy 154	7	pool			7							1	8		10smb
Hwy 154	6	pool	nr												
Hwy 154	5	run													
Hwy 154	2	run													
Hwy 154	1	pool	30	75	20							22	14		36
Refugio	x	pool						2					PV		2
Refugio	30	run											PV		1
Refugio	24	pool											PV		36
Refugio	17	pool				1	1	1					PV	3	31
Refugio	14	pool											PV		38
Refugio	13	run			NR		1	1					PV		5
Refugio	7	pool					2	2					PV	1	46
Refugio	4	pool					3	4					PV		6
Refugio	2	pool				1		5					PV		5
Refugio	1	run											PV		
Alisal	6	pool	2			1		6				23	PV		17
Alisal	8	run										16	PV	1	13
Alisal	9	pool				1	4	65				33	PV	10	34
Alisal	20	pool	3	5	13	3	pv	nr				17	27	PV	109
Alisal	26	run		nr											
Alisal	28	pool				2	3	3				11	24	24	30
Alisal	33	run	1	nr	13	3	6	4				PV	PV		35
Alisal	37	pool		nr	14	2	10					PV	PV		15
Alisal	45	pool	4	2	29	13	3	49				PV	PV		23
Alisal	48	pool				16	19	21				PV	PV	6	22
Cargasachi	29	run		4									23	9	
Cargasachi	16	pl/run		3	1	1		2					43	21	
Cargasachi	7	run	1										7		
Cargasachi	5	run											1	1	
Cargasachi	3	run			3									1	
Cargasachi	1	run		2	2										

Table 5-8. Distribution of Largemouth Bass Less Than 6 Inches in 1995-96 Visual Surveys (PV = Poor Visibility, no survey; nr = not recorded).

Reach	Unit #	Habitat Type	Number of Largemouth Bass less than 6 Inches Observed in Snorkel Surveys.												
			Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96	Jun 96	Jul 96	Aug 96
Hwy 154	12	run	nr	3	nr										
Hwy 154	10	run		1									2		
Hwy 154	9	lgr		ns									nr		
Hwy 154	8	run	1		26								5		
Hwy 154	7	pool	3	27	104							30	18		2
Hwy 154	6	pool	20	22	15								3		
Hwy 154	5	run			1										
Hwy 154	2	run	6	8	1								1		
Hwy 154	1	pool	32	29	27							701	575		161
Refugio	x	pool				4	3						PV	1	
Refugio	30	run											PV	6	24
Refugio	24	pool					1						PV	23	30
Refugio	17	pool	1										PV	24	27
Refugio	14	pool											PV	50	94
Refugio	13	run			NR								PV	12	3
Refugio	7	pool						1					PV	7	11
Refugio	4	pool				10	2	7					PV		
Refugio	2	pool			4	8	23	8					PV	1	2
Refugio	1	run											PV		
Alisal	6	pool	37	16	58		25	11				2	PV		11
Alisal	8	run	2	26	5		3					5	PV	6	17
Alisal	9	pool	30	40	47	27	65	36				7	PV		22
Alisal	20	pool	8	3	30	2	NR	NR				1		PV	21
Alisal	26	run													
Alisal	28	pool	8	15	8	35	35	31				17	6	1	1
Alisal	33	run	6	NR	29	12						PV	PV		1
Alisal	37	pool		NR	11	12						PV	PV	5	2
Alisal	45	pool	13	60	800	85	6	23				PV	PV		2
Alisal	48	pool		6	10	3		6				PV	PV	3	5
Cargasachi	29	run	99	223	143	202	12	1					2	5	
Cargasachi	16	pl/run	10	100	63	56	2						12	7	
Cargasachi	7	run	10	119	34	7		1						3	
Cargasachi	5	run	33	17	110	7	3	7					24	9	
Cargasachi	3	run	32	250	185	74		6					27	6	
Cargasachi	1	run	11	137	192	194	73	65					2		

In monthly snorkel surveys in 1995 sculpin were most abundant in the Highway 154 reach (Table 5-9). The 1993 survey also found that sculpin were relatively abundant in riffles downstream from Bradbury Dam and in the first riffle above the Highway 154 Bridge (Entrix 1995). Abundance in the Refugio reach was only about a tenth that in the 154 reach. Abundance in the Alisal reach was about half that in the Refugio reach. Sculpin abundance appeared to decline somewhat in both the Refugio and Alisal reaches as the fall of 1995 progressed. Very few were seen in the Alisal reach after December, 1995, or in the Refugio reach after January, 1996, and numbers never rebounded in surveys through August 1996. Sculpin abundance was reduced by orders of magnitude in the Highway 154 reach in August 1996 compared to August 1995. Only a few sculpin were seen in the Cargasachi reach. Sculpin distribution appears to somewhat parallel that of rainbow trout/steelhead and may be correlated with dominance of cobble and boulders in the substrate. Although the majority of trout greater than six inches were observed in the Long Pool and Habitat Unit 7, most of the sculpin were in riffle, run and pool habitats upstream of the Long Pool.

Pacific Lamprey

In the 1993 qualitative surveys, one adult Pacific lamprey was collected near San Lucas Bridge and one ammocete (larval lamprey), 73 mm in length (2.9 inches), was collected in a downstream migration trap in the mainstem just upstream of Alisal Road on May 26, 1994. Three adult lamprey were taken in a downstream migrant trap fished in the mainstem in the Alisal reach in 1996. They ranged in length from about 18.5-19 inches; two were captured on February 14 and one on March 20. Also, one spawning pair was observed near the tail of the spill basin on March 14, 1996, and a spawning pair was observed 300 feet upstream from the long pool in March, 1995. Mean daily river flow at Lompoc (Narrows gage) was 100-160 cfs between February 1 and February 8 but was only 20-40 cfs during most of January. The two lamprey captured on February 14 suggest that they can enter the river and migrate upstream at least as far as the spill basin when mean daily flow at Lompoc is 160 cfs and possibly lower. However, the possibility that these fish entered the river during the preceding winter and spent the summer in a pool cannot be eliminated.

Rainbow Trout/Steelhead

Rainbow trout/steelhead have been captured and observed throughout the upper three reaches where surveys have been conducted in the mainstem (Highway 154, Refugio, and Alisal reaches) (Tables 5-10, 5-11). Rainbow trout/steelhead have not been observed in the lower survey reach near Lompoc (Cargasachi reach). Greatest numbers of adult rainbow trout/steelhead have been observed in the Highway 154 reach, primarily in the long pool. Young-of-year have been observed exclusively in the Highway 154 reach during the summer and fall of 1995, likely the result of spawning activity in Hilton Creek. Juvenile rainbow trout/steelhead, generally 5-8 inches in length, have been observed in different areas in the Highway 154, Refugio, and Alisal reaches during surveys in 1995 and 1996. Trout larger than 6 inches in length were generally more abundant in 1995, a year following high winter runoff and flood releases from Cachuma, than in 1996, a year with low winter runoff and no flood releases. By December 1995 many of the rainbow trout/steelhead observed were between 8 - 10 inches in length during surveys conducted in the summer of 1996, rainbow trout/steelhead in the 9 - 12 inch range were observed (Ed Ballard, personal communication, November, 1996).

Table 5-9. Distribution of Prickly Sculpin in 1995-96 Visual Surveys (PV = Poor Visibility, no survey; nr = not recorded).

Reach	Unit #	Habitat Type	Number of Sculpin Observed in Snorkel Surveys.												
			Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96	Jun 96	Jul 96	Aug 96
Hwy 154	12	run	NR	100	100										
Hwy 154	10	run	100	100	100							42	70		3
Hwy 154	9	lgr	100		100							NR	NR		1
Hwy 154	8	run	100	100	100							8	8		2
Hwy 154	7	pool	1000	1000	100							1	22		2
Hwy 154	6	pool	1000	500	200							22	67		5
Hwy 154	5	run	250	200	100							5	3		3
Hwy 154	2	run	200	500	100							6	33		2
Hwy 154	1	pool	32	62	100							3			
Refugio	x	pool	100	62	90	25	22	16					PV		
Refugio	30	run	12	13	18			1					PV	4	2
Refugio	24	pool	20	7	11								PV		1
Refugio	17	pool	23	30	10	1	2	1					PV	2	1
Refugio	14	pool	40	6	88	8	21	22					PV		1
Refugio	13	run	5	4	NR	7	2	32					PV		
Refugio	7	pool	125	27	90	30	22	13					PV	6	1
Refugio	4	pool	11	25	40	20	5	30					PV		
Refugio	2	pool	55	36	42	30	18	31					PV		
Refugio	1	run	1	19	23	2							PV		
Alisal	6	pool	1	3	8		2	1				1	PV		
Alisal	8	run	1		8		1	3					PV		
Alisal	9	pool	2	3	12			8				1	PV	2	
Alisal	20	pool	0				PV	PV				1		PV	
Alisal	26	run	6	NR											
Alisal	28	pool	29	3	30	12	50	34				6	1		1
Alisal	33	run	2	NR								PV	PV		
Alisal	37	pool		NR	12	7						PV	PV		
Alisal	45	pool	1	3								PV	PV		1
Alisal	48	pool	50		100	35	5	10				PV	PV		
Cargasachi	29	run		1											
Cargasachi	16	pl/run		1											
Cargasachi	7	run	3					1							
Cargasachi	5	run	1												
Cargasachi	3	run	1	1											
Cargasachi	1	run													

Table 5-10. Distribution of Rainbow Trout/Steelhead Larger Than 6 Inches in 1995-96 Visual Surveys (PV Poor Visibility, no survey; nr = not recorded).

Reach	Unit #	Habitat Type	Number of Rrainbow Trout/Steelhead Larger Than 6 Inches Observed in Snorkel Surveys.												
			Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96	Jun 96	Jul 96	Aug 96
Hwy 154	12	run													
Hwy 154	10	run													
Hwy 154	9	lgr													
Hwy 154	8	run													
Hwy 154	7	pool	5	19	4							3	4		1
Hwy 154	6	pool													1
Hwy 154	5	run													
Hwy 154	2	run	1												
Hwy 154	1	pool	82	65	47							11	15		23
Refugio	x	pool		1	2	7	5	3					PV		
Refugio	30	run		3	6		1	5					PV		
Refugio	24	pool	3					3					PV		
Refugio	17	pool	37		1	9	8	4					PV		1
Refugio	14	pool			1								PV		
Refugio	13	run											PV		
Refugio	7	pool					1						PV		
Refugio	4	pool											PV		
Refugio	2	pool	3										PV		
Refugio	1	run											PV		
Alisal	6	pool	3	6	6	1	1						PV		
Alisal	8	run											PV		
Alisal	9	pool	4	6	4		2	5					PV		1
Alisal	20	pool					PV	PV				6	18	PV	6
Alisal	26	run													
Alisal	28	pool	10	11	21	36	28	24				4	6	4	6
Alisal	33	run										PV	PV		
Alisal	37	pool										PV	PV		
Alisal	45	pool	15	5	4	1						PV	PV		
Alisal	48	pool	0	2	2							PV	PV		
Cargasachi	29	run													
Cargasachi	16	pl/run													
Cargasachi	7	run													
Cargasachi	5	run													
Cargasachi	3	run													
Cargasachi	1	run													

Table 5-11. Distribution of Rainbow Trout/Steelhead Smaller Than 6 Inches in 1995-96 Visual Surveys (PV = Poor Visibility, nr = not recorded).

Reach	Unit #	Habitat Type	Number of Rralnbow Trout/Steelhead Smaller Than 6 Inches Observed In Snorkel Surveys.												
			Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Feb 96	Mar 96	Apr 96	May 96	Jun 96	Jul 96	Aug 96
Hwy 154	12	run	nr		3										
Hwy 154	10	run	38	5	7										
Hwy 154	9	lgr	6	7											
Hwy 154	8	run	19	2	9										
Hwy 154	7	pool	20	24	27										
Hwy 154	6	pool	7	2	5										
Hwy 154	5	run	3		2										
Hwy 154	2	run	1	3	3										1
Hwy 154	1	pool	7												
Refugio	x	pool													
Refugio	30	run	2												
Refugio	24	pool													
Refugio	17	pool	8	1											
Refugio	14	pool	1												
Refugio	13	run													
Refugio	7	pool													
Refugio	4	pool													
Refugio	2	pool													
Refugio	1	run													
Alisal	6	pool	3		1										
Alisal	8	run			2										
Alisal	9	pool	3												
Alisal	20	pool													
Alisal	26	run													
Alisal	28	pool	3												
Alisal	33	run													
Alisal	37	pool													
Alisal	45	pool	2												
Alisal	48	pool	3												
Cargasachi	29	run													
Cargasachi	16	pl/run													
Cargasachi	7	run													
Cargasachi	5	run													
Cargasachi	3	run													
Cargasachi	1	run													

1993-94 Spawning Season

In 1993, the SYRTAC evaluated the fish community in qualitative surveys from the stilling basin below Bradbury Dam downstream to the Highway 154 Bridge (Entrix 1995). Bradbury Dam was spilling until June, 1993 and after that approximately 10 cfs was released through the summer (Section 2). The release provided continuous flow through the reach although flow downstream of the Highway 154 Bridge was substantially less than the releases. Release was reduced to 5 cfs in October and to less than 1 cfs in November (Section 2; Appendix A). In November, streamflow became intermittent in some sections.

During the 1993-94 surveys, five adult rainbow trout/steelhead were observed in the lower end of the stilling basin by observers walking the shoreline in October and November, 1993 and in February 1994. Six adults from 15 to 21.5 inches in length were taken by angling surveys in 1993. Tissues were collected from these fish for the purpose of genetic evaluation. Four adult rainbow trout/steelhead were observed a short distance downstream of Bradbury Dam (Site 4), also in October and November 1993 and seven adults were observed there in May 1994. Two to three adult rainbow trout/steelhead were observed in one pool approximately 0.25 miles upstream of the confluence with San Lucas Creek in October 1993 but these fish were not observed during the November survey. This habitat unit was dry in May, 1994. One additional adult rainbow trout/steelhead was observed in the pool just downstream of the Highway 154 Bridge in October 1993. In April, 1994 one rainbow trout/steelhead, 17 inches in length, was found dead about one half mile downstream of Bradbury Dam and a second of approximately the same size, was observed in an isolated pool approximately 100 yards downstream. A large proportion of the river between the stilling basin and the Highway 154 Bridge was dry on 29 April 1994, including several of the habitat units sampled in 1993. All rainbow trout/steelhead were adults at least 15 inches in length. No rainbow trout/steelhead fry or juveniles were collected or observed during the 1993 surveys.

Adult steelhead observed in the late summer and fall of 1993 could have been anadromous fish that migrated upstream in the winter of 1992-93 and remained in the river following spawning in the winter and late-spring of 1993, but it is not likely. Adequate streamflow was available for these fish to migrate back down the Santa Ynez River until at least June in 1993. Many of these fish had severely eroded fins which are common in hatchery-reared rainbow trout/steelhead. The mtDNA analysis of five out of the six fish examined were of types common among hatchery fish (the remaining fish exhibited an mtDNA type that is generally more common among southern California populations). Rainbow trout/steelhead with similar genetic markers are annually planted into Lake Cachuma. Spills during the winter of 1992-93 could have entrained rainbow trout/steelhead from the reservoir or induced them to swim downstream.

CDFandG reviewed scale samples from 13 rainbow trout/steelhead collected in the Santa Ynez River below Bradbury Dam in 1993 and 1994 (Titus, 1995). None of the scales exhibited growth patterns typical of anadromous steelhead from other systems. "Some" of the scales exhibited a high degree of homogeneity in circulus formation during their early life history, and may be indicative of rearing in a hatchery environment. Most, however, appeared to have a natural grown pattern as reflected in the heterogeneity of circulus formation. Scale samples of seven of the eight rainbow trout/steelhead collected in 1993 exhibited good growth during the past year. CDFandG concluded that "It is conceivable that the relatively good growth in 1993 was the result of a short sojourn in the marine environment, perhaps the Santa Ynez River lagoon. Another explanation is that the rainbow trout/steelhead responded favorably to enhanced in-river conditions provided by the higher flow conditions during late 1992-early 1993." The above conclusions are based on a small sample size. Scale samples have been collected from adult rainbow trout/steelhead captured in traps in Hilton and Salsipuedes creeks, and from electrofishing surveys in 1995 and 1996. These should provide additional insights into the origin and life history patterns of the rainbow trout/steelhead population in the Santa Ynez River below

Bradbury Dam in the future.

Due to the low flows in the Santa Ynez River, 1994 sampling of the mainstem was limited to: 1) downstream migrant trapping during the late spring and early summer, 2) trapping downstream fish movement during the WR 89-18 releases, 3) snorkel surveys of the long pool where adult rainbow trout/steelhead had been observed, and 4) snorkel surveys near the cities of Santa Ynez and Solvang during the WR 89-18 releases.

Reconnaissance level snorkel surveys for fish abundance and distribution were conducted at a few locations in the mainstem during the summer of 1994. In 1994, minimal releases from Bradbury Dam were made from the MOU Fish Reserve Account from June 16 to June 27 to maintain suitable habitat for rainbow trout/steelhead in the Long Pool (Section 2). Releases began at the 0.5 cfs rate and were gradually increased to 1.6 cfs. Starting June 28, releases under WR 89-18 began at 20 cfs. Releases were reduced to 10 cfs on July 3 with a two cfs decrease daily until releases were ceased on July 7, 1994. As a result of the WR 89-18 releases, the long pool was filled to a water level more suitable to maintain fish habitat. Releases from the 1994 MOU Fish Account to maintain the long pool were begun again on July 11. On July 25 and extending through October 31 releases under WR 89-18 were again made. Initial releases started at 150 cfs, continued for 12 days, and were reduced to roughly 70 cfs on August 7. After August 7, flows were gradually reduced to 30 cfs for the remainder of WR 89-18 controlled releases. The WR 89-18 releases created a live stream from Bradbury Dam to V Street in Lompoc that continued until the rainy season began.

A downstream migrant trap was deployed in the Santa Ynez River between May 22 and June 10, 1994. It was located approximately 175 feet below the confluence of Alamo Pintado Creek and the Santa Ynez River adjacent to the Alisal Golf Course in Solvang. The purpose of the trapping was to determine if any rainbow trout/steelhead or Pacific lampreys were outmigrating to the ocean. Stickleback and fathead minnows were the fish species captured in the greatest numbers. At the trap site, daily water temperatures approached or exceeded the upper tolerance of rainbow trout/steelhead on most days. No rainbow trout/steelhead were captured.

At the start of WR 89-18 releases on July 28, 1994 the migrant trap was re-deployed about 5 miles downstream from Bradbury Dam to document downstream migration of fish during the WR 89-18 releases. No rainbow trout/steelhead were captured during the trapping.

1994-95 Spawning Season

Routine snorkel surveys in the mainstem were initiated in August of 1995. In August a number of rainbow trout/steelhead of size classes larger than 12 inches were observed in pools in the Highway 154 reach. The majority of these were in a long, deep pool about half a mile downstream of Bradbury Dam (long pool). Also present in the Highway 154 reach were a number of rainbow trout/steelhead in the 0-3 inch, 3-6 inch, and 6-12 inch size classes. Although rainbow trout/steelhead in the 0-3 and 3-6 size classes were frequently found in run habitat, rainbow trout/steelhead larger than 6 inches were found almost exclusively in pools. The 0-3 inch fish were young-of-year that likely originated in Hilton Creek although the possibility of spawning in the mainstem cannot be ruled out. In August surveys, young-of-year rainbow trout/steelhead were seen only in the Highway 154 reach. The 3-6 and 6-12 inch fish could have been early hatching or fast growing young-of-year from Hilton Creek (3-6 inch fish only), fish hatched the previous spring (1994) in the mainstem or tributaries, or fish that came from Lake Cachuma in releases from Bradbury Dam (possibly production from tributaries upstream of Lake Cachuma).

Rainbow trout/steelhead continued to be present in the Highway 154 reach through the fall of

1995. The 0-3 inch class was not observed after September but these fish would be expected to grow into the larger size classes by that time. Electrofishing surveys were conducted in the Highway 154 reach on September 1 and October 19, 1995. These surveys confirmed the presence of young-of year fish (lengths from 3.7 to 4.5 inches in September) as well as older rainbow trout/steelhead. Condition factors (a length to weight ratio that gives an "index of plumpness") for young-of year fish in September ranged from 0.93 to 1.36 and averaged 1.20. Healthy rainbow trout/steelhead generally have condition factors of 1.0 or more. In October, one adult rainbow trout/steelhead about 16 inches in length had a fairly low condition factor of 0.49. Condition factor for all other rainbow trout/steelhead in October ranged from 1.11 to 1.28 and averaged 1.19.

Moderate numbers of rainbow trout/steelhead in the 3-6 and 6-12 inch size classes were also distributed within the Refugio and Alisal reaches throughout the late summer and fall of 1995 (Tables 5-10, 5-11). Fish larger than 12 inches were also observed in the Alisal reach though not in the Refugio reach. No rainbow trout/steelhead were found in the furthest downstream study reach (Cargasachi Ranch, approximately 24 miles downstream of Bradbury Dam).

In mainstem electrofishing surveys at the end of August 1995, rainbow trout/steelhead in the Alisal and Refugio reaches ranged from 5.5-8 inches in length. These fish appeared to be in healthy condition, were free of external parasites and disease and all fins were in perfect condition. Condition factors for these fish ranged from 1.09 to 1.48 and averaged 1.32.

Rainbow trout/steelhead of the size seen in Alisal and Refugio reaches were most likely in their second year (hatched in the spring of 1994). They could have been progeny of the adult rainbow trout/steelhead that had been present in the Highway 154 reach in the fall and winter of 1993 and the spring of 1994. Two adults were captured in traps as they migrated into Hilton Creek in February 1994 and these or other fish could have spawned in Hilton Creek though no young-of-year were reported in Hilton Creek or the Highway 154 reach in the spring of 1994. However, since there were no surveys to look for them it is possible that these fish hatched in Hilton Creek and reared in the mainstem through the summers of 1994 and 1995. No rearing could have occurred in Hilton Creek (at least the lower section) over the summer of 1994 since the creek dried up by late May. Rearing in the mainstem could have been possible only in some of the larger pools, as much of the reach was dry prior to the WR 89-18 releases. It is also possible that these 2-year old fish had hatched in tributaries and migrated to the mainstem sometime between the spring of 1994 and early summer of 1995, most likely during the winter of 1994-95. A third possibility is that these fish came from Cachuma reservoir during flood control releases during the winter of 1994-95.

Whatever their origin, snorkel surveys verified that in some habitats in the Highway 154, Refugio, and Alisal reaches of the mainstem (up to 9.8 miles downstream from the dam), juvenile rainbow trout/steelhead survived through the late summer and into the winter of 1995-96 (Table 5-10, 5-11). Streamflow was low to intermittent during the entire period (Figure 5-2) and there were high temperatures and low levels of dissolved oxygen during the early part of the period (Figures 5-3 and 5-4). Rainbow trout/steelhead larger than 6 inches in length were present in two pools in the Highway 154 reach during August surveys. Trout survived through the late summer and fall in these habitats, though possibly with some reduction in numbers (Table 5-12). In August, 82 rainbow trout/steelhead were observed in the long pool, 65 were observed in September, and 47 were observed in October. A few rainbow trout/steelhead were also observed in the confluence pool (Unit 7) in each of these months. The decline in abundance of rainbow trout/steelhead in the Long Pool was primarily for fish larger than six inches. Abundance of smaller trout remained relatively constant throughout the 1995 surveys.

In the Refugio reach rainbow trout/steelhead were seen each month during surveys between August 1995 and January 1996 (Table 5-12). Rainbow trout/steelhead were also seen in June 1995 in the

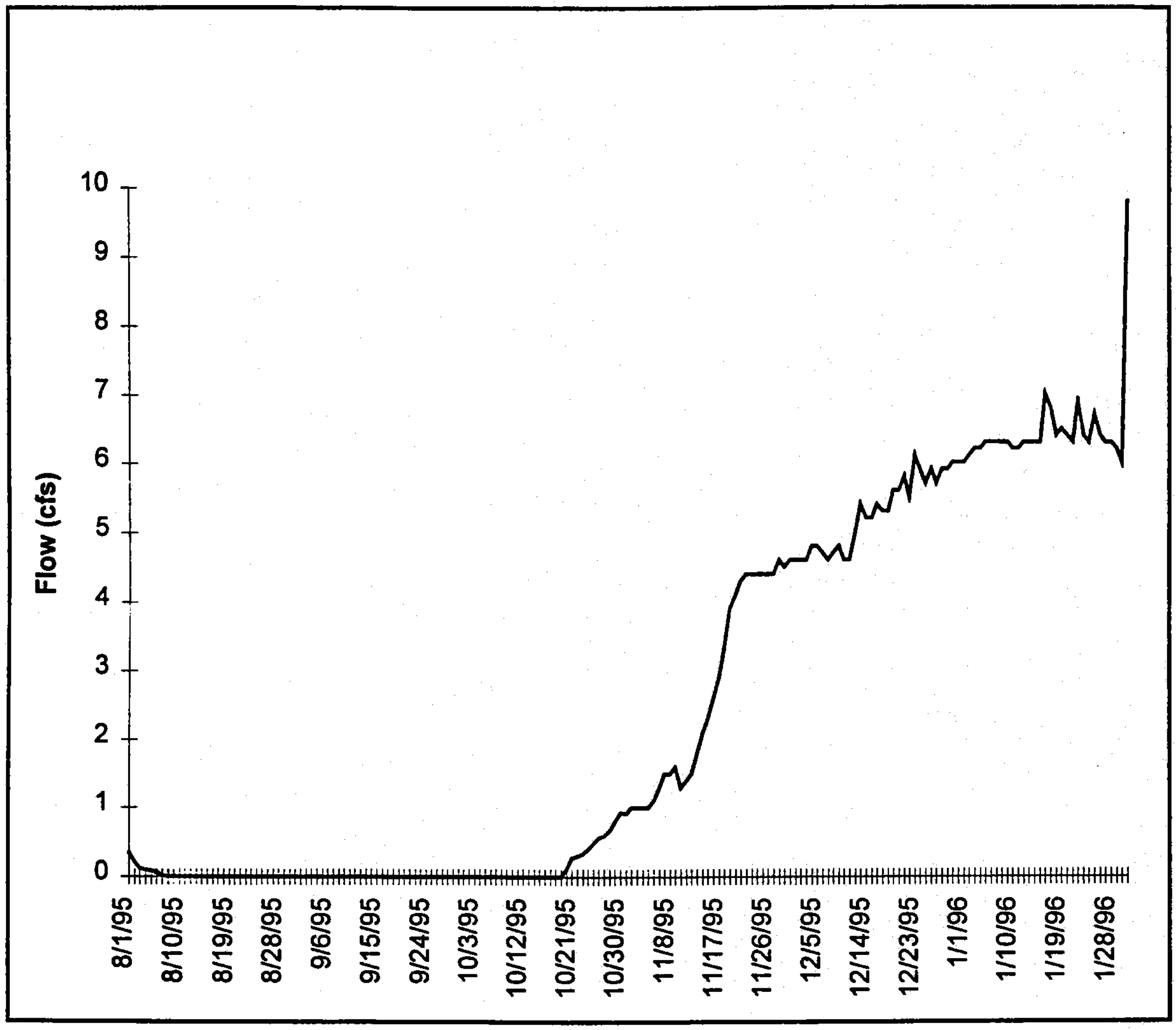


Figure 5-2. **Flow in the Santa Ynez River at Solvang during 1995-96 snorkel surveys.**

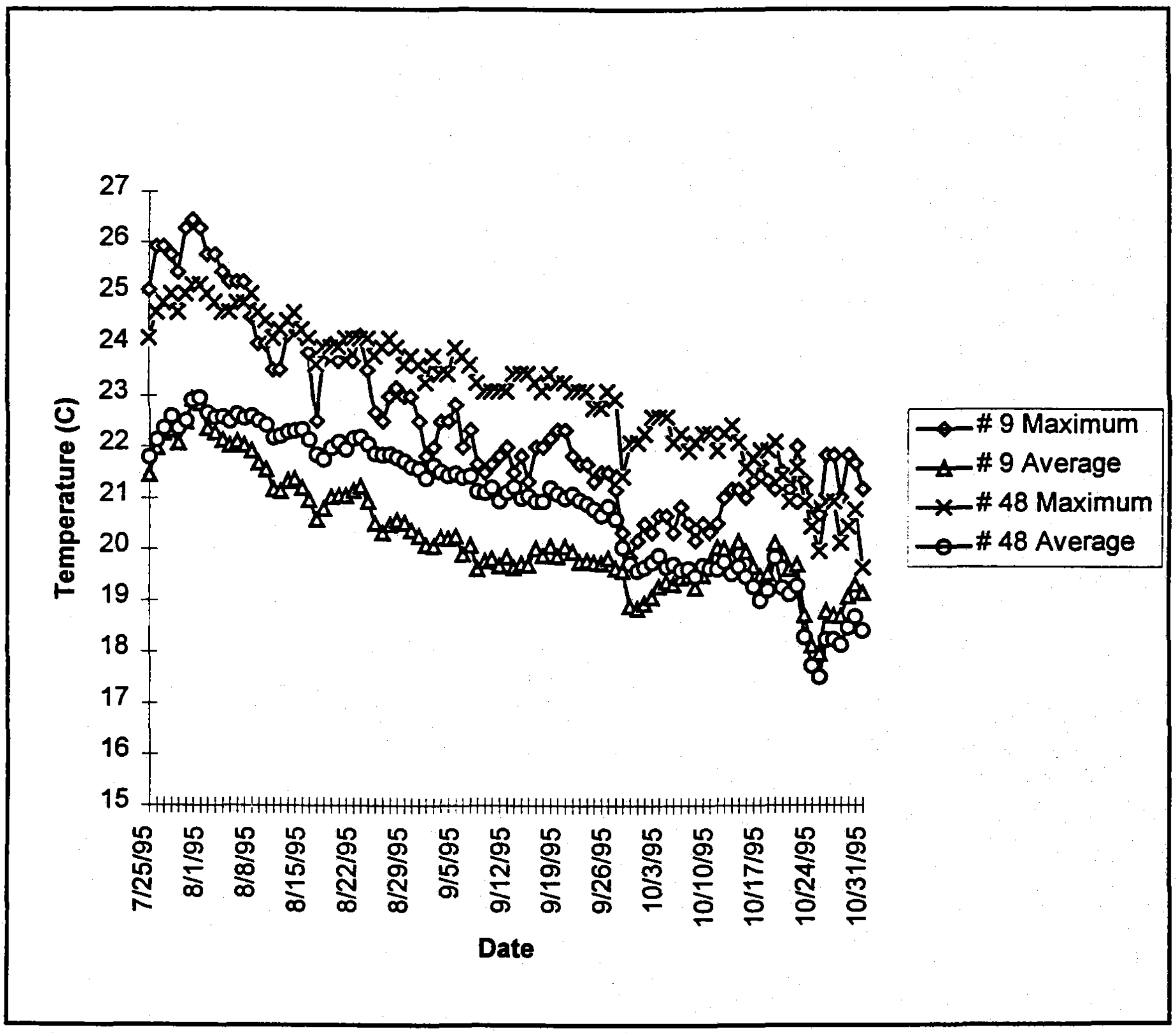


Figure 5-3. **Surface water temperature at Alisal Habitat Units 9 and 48 - July 25 to August 31, 1995.**

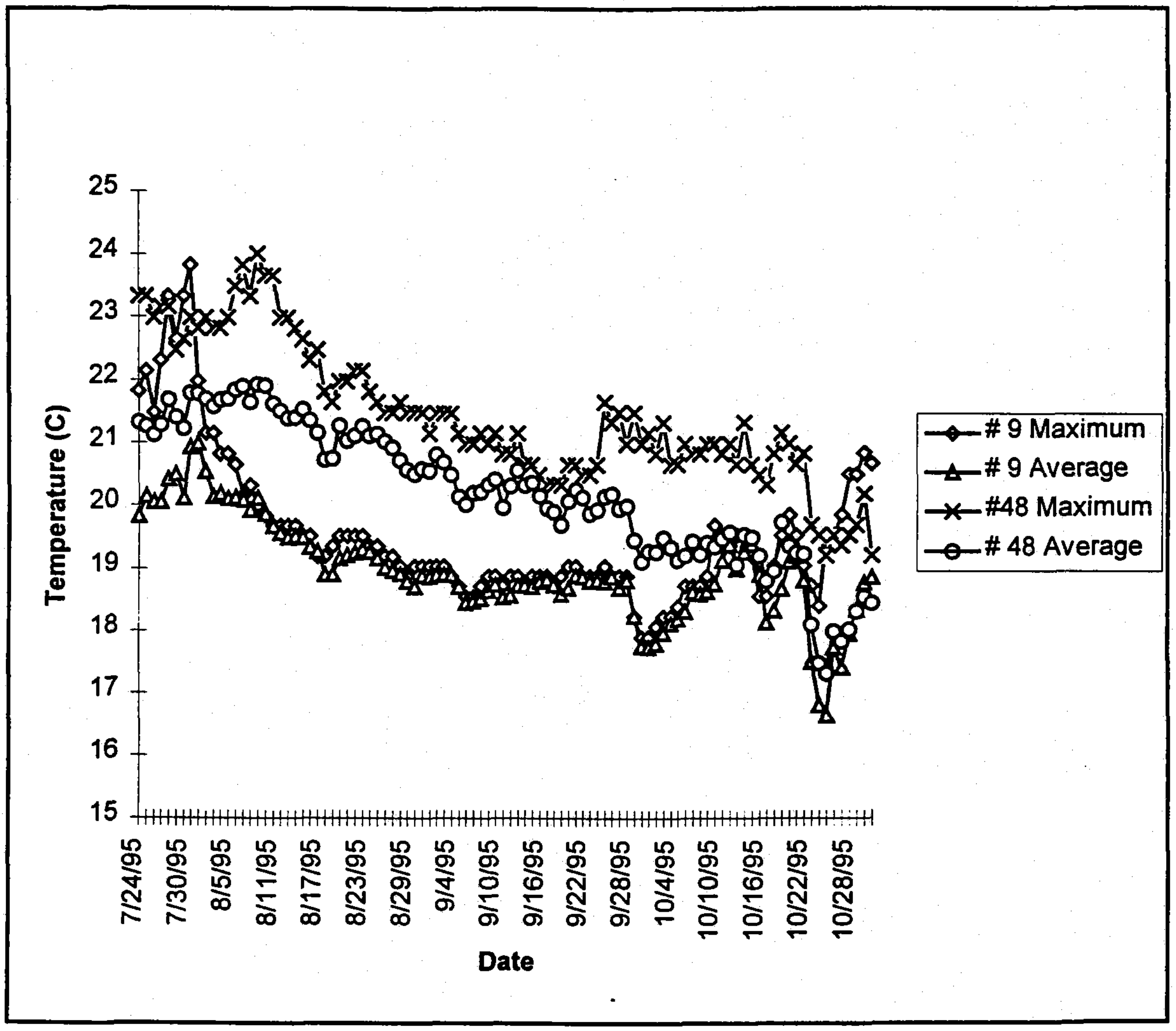


Figure 5-4. **Bottom water temperature at Alisal Habitat Units 9 and 48 - July 24 to October 31, 1995.**

Table 5-12. Comparison of Factors Potentially Influencing Steelhead/Rainbow Trout Survival in the Alisal Reach.

Reach	Unit #	Habitat Type	Number of Steelhead/Rainbow Trout Observed in Snorkel Surveys. Aug 95	Sep 95	Oct 95	Nov 95	Dec 95	Jan 96	Maximum Depth (ft) in July	Mean Depth (ft) in July	Surface Area (sq. ft) in July	% Canopy	Average % Coverage Floating Algae *	Bass 6-12" in August	Bass > 12" in August
Highway 154	9	lgr	6	7		ns	ns	ns	0.8	0.53	308	100	0	0	0
Highway 154	12	run			3	ns	ns	ns	1.25	0.8	266	50	0	0	0
Highway 154	10	run	38	5	7	ns	ns	ns	1.1	0.6	756	70	5	0	0
Highway 154	8	run	19	2	9	ns	ns	ns	1.2	0.78	999	90	0	0	0
Highway 154	1	pool	89	65	47	ns	ns	ns	9.9	5	151280	0	0	0	30
Highway 154	6	pool	7	2	5	ns	ns	ns	1.75	1.04	1950	25	5	0	0
Highway 154	5	run	3		2	ns	ns	ns	1.05	0.63	1330	75	0	0	0
Highway 154	2	run	2	3	3	ns	ns	ns	2.1	0.76	636	70	0	0	0
Highway 154	7	pool	25	43	31	ns	ns	ns	3.2	2.06	5544	30	5	0	0
Refugio	24	pool	3					3	4.4	2.2	22753	3	48	0	0
Refugio	2	pool	3						4.1	1.4	2088	1	79	0	0
Refugio	17	pool	45	1	1	9	8	4	4	2.6	7876	5	59	0	0
Refugio	x	pool		1	2	7	5	3	3.65	1.9	2460	30	40	0	0
Refugio	30	run	2	3	6		1	5	4.7	3.1	6290	5	50	0	0
Alisal	48	pool	6	2	2				4	2.4	4361	0	41	0	0
Alisal	45	pool	19	5	4	1			4.5	2.4	9000	25	63	1	3
Alisal	6	pool	6	6	8	1	1		6	2.5	2912	0	48	2	0
Alisal	9	pool	7	6	4		2	5	5.1	2.9	3815	30	19	0	0
Alisal	28	pool	16	11	21	35	25	24	3.6	1.8	3384	75	10	0	0
			296	162	155	53	46	44							

* Numbers represent average from July to October. Algae percent coverage began to decrease in October and November in most habitat units.

vicinity of Refugio Bridge and Habitat Unit X. All fish were 5-6" in length, and were seen in different habitat types. Observations in the Refugio reach are difficult to interpret since, within any given habitat unit, counts fluctuated from month to month. Four habitat units held rainbow trout/steelhead in August, Units 30, 24, 17 and 2. Trout were not seen again in Unit 2 and were not seen until January in Unit 24. A total of 45 rainbow trout/steelhead were seen in Unit 17 in August, one was seen in September, one was seen in October and several were seen each of the following months. Several interpretations are possible but assuming no migration occurred, survival within the unit throughout the period was not good. In Unit 30 rainbow trout/steelhead were seen from August through October, indicating that they did survive in Unit 30. In Habitat Unit X (999), rainbow trout/steelhead were not seen until September but were then seen on each survey through January. It is not clear whether these fish were present before the September survey and were just not seen or whether they moved into the units from adjacent un-surveyed areas after the August survey. This points out the desirability of tightening up the visual surveys and possibly incorporating some quantitative methods to improve the precision of the snorkel surveys. Tagging individual fish and keeping record of dry streambed and other features that may influence movement between habitats would also improve interpretation of the data.

In the Alisal reach, rainbow trout/steelhead survived the summer at stable numbers in some pools, but gradually disappeared from others (Table 5-12). Rainbow trout/steelhead were observed in two pools (Habitat Units 9 and 28) from August 1995 through January 1996. Counts of rainbow trout/steelhead in these two pools were relatively consistent over this time period, averaging three fish in one pool and 21 fish in the other (Table 5-12). All fish were in the 6-12 inch size class except for one fish estimated at over 12 inches. Fish appeared healthy and robust throughout the period with the exception of some behavioral abnormalities (lethargy, rapid ventilation) during the period with the worst water quality conditions. In a third pool (Habitat Unit 6) trout were present from August through October, but only one fish was seen in November and December.

In two other pools in the Alisal reach (Habitats Units 6, 45, and 48), rainbow trout/steelhead present in August declined through October, and apparently disappeared (Table 5-12). They apparently moved to other areas or perished. Movement to other areas would have been likely only after the October survey, due to low streamflow throughout the fall and early winter of 1995 (Figure 5-1).

Habitat variables recorded during the habitat surveys were examined in an attempt to gain insight into why rainbow trout/steelhead survived in some pools and not in others. The August survey was considered most important since temperature and dissolved oxygen reach their most unfavorable levels during July and August (habitat variables were not measured in July). Habitat variables were recorded at the time of the survey and represent "snapshots" in time (Table 5-13). These data are not ideal since, even though all habitats were usually assessed on the same day or not more than a day apart, variables such as temperature and dissolved oxygen show significant diel fluctuation and would be influenced by the time of day of the survey (Section 3). Rainbow trout/steelhead survival may be determined largely by conditions during discrete time periods such as mid-afternoon thermal maxima and pre-dawn dissolved oxygen minima.

Table 5-13. Temperature and Dissolved Oxygen Measured during Snorkel Surveys in Selected Pools of the Alisal reach.

Habitat Number	Date	Time	Surface Temp. (C)	Bottom Temp. (C)	Surface D.O. (mg/l)	Bottom D.O. (mg/l)
48	8/9/95	3:15 pm	24.8	23.6	9.38	6.73
45	8/9/95	2:45 pm	23.8	17.6	9.12	1.16
6	8/4/95	11:20 am	21.1	21.4	8.68	7.14
9	8/4/95	NA	NA	NA	NA	NA
28	8/7/95	2:30 pm	21.1	18.8	3.80	3.70
48	9/13/95	11:37 am	21.2		7	
45	9/13/95	11:18 am	21		5.45	
6	9/13/95	9:22 am	19.7		2.38	
9	9/13/95	9:58 am	18.8		3.35	
28	9/13/95	14:30 pm	19.2		3.76	
28	9/14/95	10:44 am	19.0		4.40	
48	10/6/95	15:15 pm	21.1	20.9	10.75	14.2
45	10/6/95	14:44 pm	21.3	20.7	12.2	7.15
6	10/5/95	10:52 am	19.8	19.3	6.8	7.1
9	10/5/95	11:29 am	19	18.1	4.36	2.41
28	10/5/95	15:10 pm	19.9	18.2	4.41	1.34
28	10/6/95	10:52 am	19.8	19.4	4.91	3.85

Four of the pools were thermally stratified during the surveys. Surface temperature was not recorded for the August survey of habitat 9 but was only 21.1 C in habitat 28 at 2:30 pm. Bottom temperature in the two pools, where rainbow trout/steelhead did not survive, was 17.6 and 23.6 C, but the dissolved oxygen level at the bottom of the coolest pool was only about 1 mg/l, well below a suitable concentration. Bottom temperature in pool 28, where fish survived, was relatively cool the afternoon of August 7, but dissolved oxygen level was also low (3.70 mg/l). Again, water quality parameters in pool number 9 were not recorded. Habitat Unit 6, where rainbow trout/steelhead survived through October, but later disappeared, was not thermally stratified on August 4, but had relatively high dissolved oxygen. Anglers were observed on several occasions fishing in Unit 6, and they may have removed trout from the unit. No firm conclusions can be drawn from this data.

Diel studies of temperature and dissolved oxygen were conducted during late-August 1995 (Section 3). These surveys indicated that dissolved oxygen levels in pools of the Alisal reach fluctuated significantly over the course of a day (Table 3-4, Site 3 and 4). Evening dissolved oxygen levels were generally high while those in the morning were low. This fluctuation occurs at all depths within the pool but was most pronounced at the surface. The same pattern holds for temperature though the magnitude of diel fluctuation was less for temperature than for dissolved oxygen. During the course of a typical summer day, surface waters become increasingly warmer as the day progresses and rainbow trout/steelhead would have to move deeper in the pool to find cooler temperatures. Dissolved oxygen levels also increase during the day, greatly at the surface but less in the deeper water. If dissolved oxygen increases enough in the deeper parts of the pool rainbow trout/steelhead could find cooler water by moving deeper. At night when dissolved oxygen levels drop, rainbow trout/steelhead could again move into the surface waters as they cool.

During snorkel surveys of Habitat Unit 45, divers observed rainbow trout/steelhead near the middle of the water column. Temperature and dissolved oxygen at this level would be expected to be intermediate between the levels for surface and bottom shown in Table 5-13. Their position in the water column may represent the coolest water available, where oxygen was still sufficient for survival.

Temperatures were recorded continuously in two pools in the Alisal reach (Section 3). Fortuitously, one recorder was placed in habitat unit 9 (a pool where rainbow trout/steelhead survived the summer) and another was placed in habitat unit 48, a pool where rainbow trout/steelhead did not survive. Temperature recording was initiated in May 1995 in habitat 48 but not until July 25 in habitat 9. Daily maximum surface temperature reached higher levels in habitat 9 during the last week of July and first week of August, was similar in the two habitats until about August 22, but was 1-2 degrees cooler in habitat unit 9 until mid-October (Figure 5-3). Daily average surface temperature, in contrast, was similar in both habitats through early August and after early October, but was 1-2 C cooler in habitat 9 through August and September. Daily maximum bottom temperature was consistently cooler in habitat 9, often by as much as 2 C (Figure 5-4). Daily average bottom temperature was cooler in habitat 9 in late July and early August by as much as 3 C but was similar in both habitats thereafter.

As discussed in Section 3-2, observations during snorkel surveys in 1995 indicated localized areas of cool water upwelling in various habitat units. These cool water areas were between 2-3 C cooler than the surrounding water. The cool water upwelling usually did not influence an area of more than two to three square feet and may or may not have been reflected in the temperature records depending on placement of the recorders.

Based on the foregoing results, no firm conclusions regarding the influence of temperature on summer survival of rainbow trout/steelhead can be drawn. Although cooler water exists at the bottom of many pools, low dissolved oxygen levels there can prevent rainbow trout/steelhead from moving into it. In spite of temperature near or exceeding temperature criteria for rainbow trout/steelhead, fish survived in some pools, and appeared to be healthy at the end of the summer. Based on observations during snorkel surveys, fish appeared to increase in size over the period, even in pools where they later disappeared. Temperature recorded in all habitat units was at the upper tolerance range for rainbow trout/steelhead and the difference in whether rainbow trout/steelhead survived or perished could be related to temperature differences of as small as 1-2 C.

In the Alisal reach, rainbow trout/steelhead survival may have been related to two other habitat variables that may interact with temperature and dissolved oxygen. In the pools where rainbow trout/steelhead did not survive, riparian vegetation was sparse and the percent of the habitat shaded by canopy was 0-25 percent (Table 5-12). In two of the pools where rainbow trout/steelhead survived riparian canopy covered 30 percent and 75 percent of the habitat. Habitat Unit 6 was an exception: rainbow trout/steelhead survived there through October with no canopy. Highest numbers of rainbow trout/steelhead were observed in habitat 28 with 75 percent riparian canopy. In pools where rainbow trout/steelhead did not survive, floating mats of algae covered a large amount, 41 percent-63 percent, of the habitat. In two of the pools where rainbow trout/steelhead survived, algae covered only 10 percent and 19 percent of the habitat. Again, the pool with the least amount of algae held the greatest number of rainbow trout/steelhead through the summer. Habitat Unit 6 was again an exception to this pattern.

Algae, like all plants, produces oxygen as part of the process of photosynthesis during the day, but consumes oxygen in respiration during the hours of darkness. Diel cyclic change in dissolved oxygen levels is described in Section 3-3. It is possible that lower levels of algae resulted in less depletion of dissolved oxygen in Alisal Habitat Units 9 and 28.

The canopy of riparian vegetation reduces solar radiation and may thereby have at least three impacts on habitat for rainbow trout/steelhead in these pools: it may inhibit the growth of algae and thereby indirectly influence levels of dissolved oxygen; it limits exposure of fish to direct sunlight and direct thermal gain; and it may slightly reduce the magnitude of daily heating, lowering daily maximum and average water temperature.

Two of the three pools where rainbow trout/steelhead did not survive also had bass in them (Table 5-12) and, though rainbow trout/steelhead larger than 6 inches in length would not be expected to be susceptible to predation, it could have been a factor. It is also possible that rainbow trout/steelhead were removed by anglers in some locations.

Following periods of high runoff in early 1996 at least two of the study pools in the Alisal reach were recolonized by rainbow trout/steelhead. Several rainbow trout/steelhead were observed in habitat 20 from May through August; rainbow trout/steelhead were not observed in this habitat the previous fall and summer. Several rainbow trout/steelhead were also observed over this period in Habitat Unit 28. These fish could have been holdovers from the previous season or may have been new residents.

<u>1995-96 Spawning Season</u>

River flow was low throughout the winter with releases from Cachuma of about 2.5-5 cfs from the fish reserve account (Section 2.3). Flow measured at Solvang increased to 10-20 cfs in early February from natural runoff with a peak of about 73 cfs on February 6 (Figure 5-5). Storm water runoff resulted in a flow increase at Solvang of 200-800 cfs on February 20-22 and flow from 150 to about 40 cfs through the end of February. Daily average flow in March gradually declined from 40 to about 10 cfs except for a brief increase to 100 cfs on March 13.

Upstream migrant trapping was conducted in the mainstem with a trap in the Alisal reach near mile 8.7 (Table 5-1). Trapping was initiated on February 29, 1996. One 9.8 inch rainbow trout/steelhead was captured on March 15.

Snorkel surveys began in May 1996. Rainbow trout/steelhead were observed in two pools in the Highway 154 reach, one pool in the Refugio reach, and two pools in the Alisal reach (Table 5-10, 5-11). All fish were greater than 6 inches in length, and most were approximately 12 inches by late summer. No young-of-year rainbow trout/steelhead were seen in the mainstem in 1996. Movement throughout the mainstem and between the mainstem and tributaries would have been possible at times during the winter, particularly during high flow periods (Figure 5-4). Rainbow trout/steelhead seen in the mainstem could have been fish that held over winter there or migrated into the mainstem from tributaries. Observations during snorkel surveys indicated that rainbow

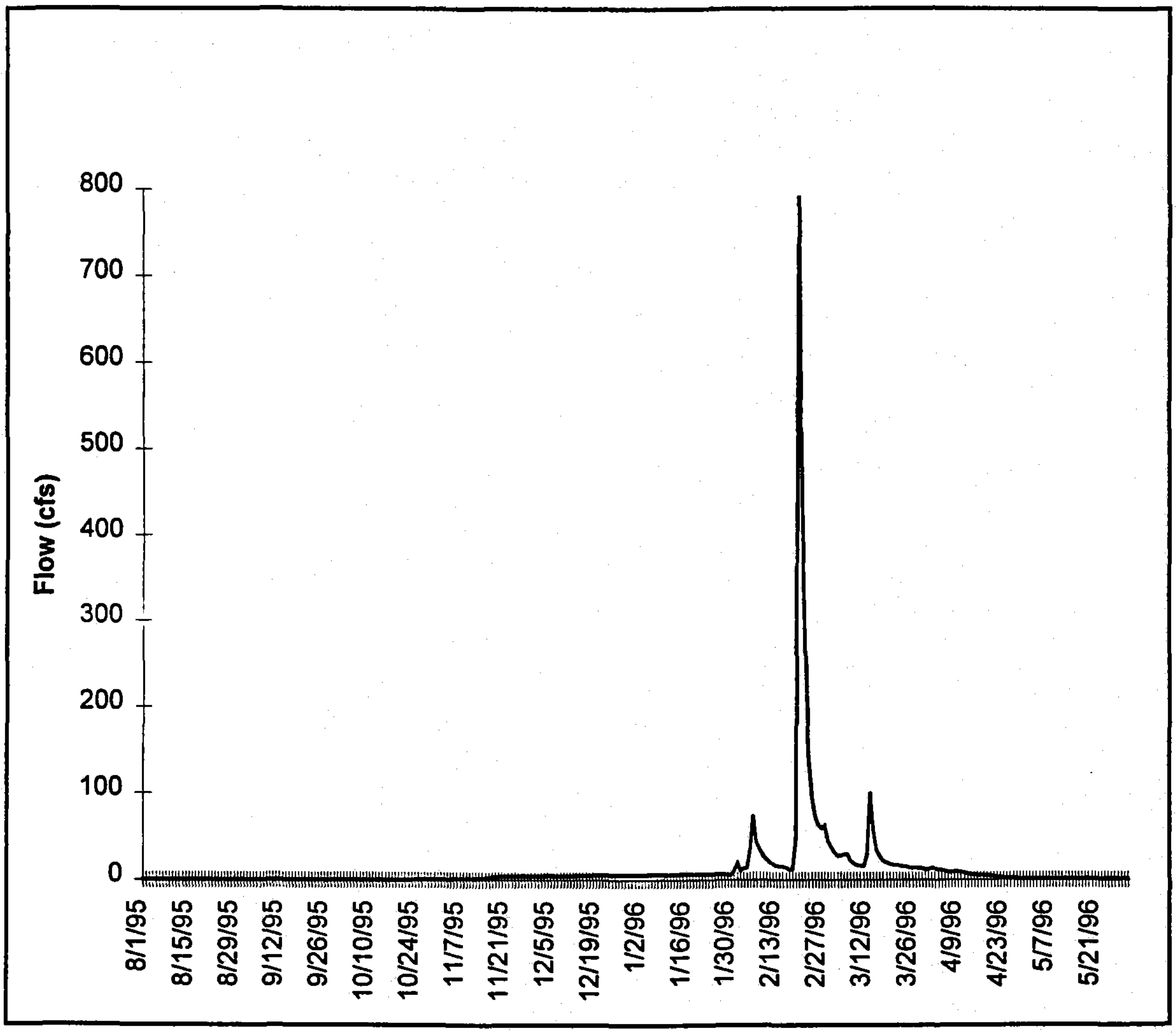


Figure 5-5. **Flow in the Santa Ynez River at Solvang, August 19, 1995 - June, 1996.**

trout/steelhead in the mainstem showed significant increase in size during 1995 and 1996. Although these observations indicate that rainbow trout/steelhead grew during the period, they should be interpreted with the following considerations:

- Growth of fish is best assessed by measuring length and/or weight of the same individuals at different time intervals. This has not been done in the SYRTAC studies since all observations involve visual estimates of unmarked fish.

- Growth estimates can be developed from changes in length frequency distributions if there is no gain or loss of individuals from the population. Bias can result from size dependent differential mortality such as size selective predation (i.e. smaller or slower growing individuals disappear from the population at a faster rate) or angling mortality. These estimates can also be biased by migration of fish into or out of the population.

- If visual estimates of length are to be used in quantitative analysis, they should be calibrated against a known standard and confidence limits should be calculated.

To the extent the SYRTAC surveys involved counts of fish in habitats isolated by surrounding dry streambed, migration can be ruled out as a bias factor. Between the summers of 1995 and 1996, increased streamflow likely allowed migration between habitats and between the mainstem and tributaries.

Based on these considerations it seems likely that rainbow trout/steelhead in the mainstem grew during both 1995 and 1996 however, the extent of growth cannot be quantified based on the available information. Observations also indicated that rainbow trout/steelhead were in good health. There were no reports of rainbow trout/steelhead that appeared to be underweight or emaciated. There were also few observations of rainbow trout/steelhead with external indications of disease such as infections from fungus or parasites.

Releases under WR 89-18 were initiated in mid-July 1996. In snorkel surveys in mid-August, rainbow trout/steelhead were still present in Alisal Habitat Units 20 and 28 and Highway 154 Habitat Units 1 and 7 where rainbow trout/steelhead have been present at least since May 1996. Rainbow trout/steelhead were also present in Habitat Unit 6 of the Highway 154 reach, Habitat Unit 17 in the Refugio reach, and in Habitat Unit 9 of the Alisal reach where they had not been seen since January 1996. Rainbow trout/steelhead were present in these habitats in spite of the loss of thermal stratification that resulted from the WR 89-18 releases. There also seemed to be some movement of rainbow trout/steelhead during this period based on their presence in August in habitats where they had not been seen before. Data collected in September and October 1996 is now available but has not been included in this analysis.

Other Species

Catfish were a minor component of the fish community at all mainstem sites. Catfish fry have been seen occasionally in the long pool, in the Alisal and Cargasachi reaches, and in Salsipuedes Creek. Crappie and sunfish were reported primarily in mainstem trapping during July and August 1994. Goldfish, carp and mosquitofish, all introduced species, have been reported from Lake Cachuma and may be found in the lower Santa Ynez River from time to time.

5.2 Lagoon

In August of 1993, a beach seining survey was conducted in the Lagoon by the SYRTAC (1994). Twelve seine hauls were made between the upstream end of the lagoon and the mouth. Ten species of fish were caught including smallmouth bass, arroyo chub, mosquitofish, stickleback, tidewater goby, starry flounder, Pacific herring, topsmelt, shiner perch, and staghorn sculpin (Table 5-14). Topsmelt, Pacific herring, and tidewater goby were abundant at several of the sampling locations. Freshwater fish (smallmouth bass, arroyo chub and mosquitofish) were found in a narrow (approximately 0.5 meter thick) freshwater lens located in the upstream end of the lagoon. Overall, the lagoon appeared to be extremely productive based on the number of fish and invertebrates collected per seine haul.

In 1993, tidewater gobies were collected throughout the lagoon, in salinities ranging from 6.5 to 16.0 ppt (SYRTAC, 1994). Tidewater goby abundance was considerably higher in the upper half of the lagoon (Stations 7-10) where the numbers of gobies per seine haul exceeded 100. The salinities at Stations 7-10 ranged from approximately 8.0 to 13.5 ppt. Tidewater goby abundance in the lower half of the lagoon was considerably lower, ranging from one to 24 per seine haul. Corresponding salinities in the lower half of the lagoon were approximately 14.0 to 16.0 ppt. During the August survey, most of the gobies observed were adult (e.g., approximately 1.5 inches in length). Observations in July 1994 indicated successful reproduction by tidewater gobies, as evidenced by the presence of large numbers of young-of-year.

Rainbow trout/steelhead have been reported only once in the Santa Ynez River lagoon. A gill net survey conducted from July 1987 through January 1988 by the CDFandG resulted in the catch of one 12 inch rainbow trout/steelhead, with the exception of young-of-year fish, rainbow trout/steelhead are not generally susceptible to capture using beach seines in an environmental such as the lagoon.

Table 5-14. **Results of beach seining survey in the Santa Ynez River Lagoon, August 30 and 31, 1993.**

Station	Top Smelt	Pacific Herring	Tidewater Goby	Staghorn Sculpin	Starry Flounder	Shiner Perch	Gambusia	Stickleback	Arroyo Chub	Smallmouth Bass
1	95	40	5	0	1	0	0	0	0	0
2	170	130	12	4	0	1	0	1	0	0
3	100+	50	24	25	1	0	0	1	0	0
4	70	45	8	4	2	1	0	0	0	0
5	0	200	1	4	3	0	0	3	0	0
6	150	150	23	6	12	5	1	0	0	0
7	0	8	200+	0	2	0	0	1	0	0
8	200+	0	100+	0	0	0	50	10	0	0
9	0	20	100+	0	1	0	100+	5	20	0
10	0	0	100+	0	0	0	1000+	0	100+	1
11	0	30	1	0	0	0	0	0	7	2

5.3 Tributaries

Salsipuedes and El Jaro Creeks

Fisheries studies in Salsipuedes Creek and its tributary, El Jaro Creek, have included upstream and downstream migrant trapping, snorkeling, and electrofishing surveys (Table 5-1). These surveys have demonstrated the presence of a reproducing rainbow trout/steelhead population in the two streams.

<u>Upstream migration</u>

A trap for upstream migrating fish was placed in Salsipuedes Creek just upstream of the Santa Rosa Road Bridge on March 3, 1994. On March 25 the trap was destroyed by high flows during a storm. The trap was replaced on March 28 after flows had receded. The trap was also briefly taken out of service on April 12-14. Operation of the upstream trap was suspended April 21 due to diminishing streamflow and high water temperature (afternoon highs of 20-21 C).

One upstream migrating rainbow trout/steelhead was captured in the Salsipuedes Creek trap in 44 days of trapping during 1994. It was taken on March 11 and was unrelated to any rainfall or flow change. It was 320 mm (12.5 inches) in length (fork), weighed slightly over one pound and appeared healthy on gross external examination. The fish was a female and it shed several eggs during handling. A photograph and scale sample were taken and the right pelvic fin was taken for genetic analysis.

During 108 days of upstream trapping in 1995, two rainbow trout/steelhead were captured on February 20, six days after a storm event. The discharge at time of capture was approximately 10 cfs and the water clarity was poor. The fish measured 368 mm (14.5 inches) and 362 mm (14.2 inches). Both fish appeared to be in robust condition and each had a clubbed right pectoral fin.

Two rainbow trout/steelhead were captured in 160 days of trapping in Salsipuedes Creek trap in 1996: one was captured on February 14 and was about 14 inches in length, the other was captured on March 1 and was about 13.5 inches in length. Both captures were made several days after peak runoff events in the mainstem.

<u>Downstream Migration</u>

A downstream migrant trap was first deployed on Salsipuedes Creek, just upstream from Santa Rosa Road bridge, from April 6, 1994 to July 1, 1994. Six young-of-year rainbow trout/steelhead ranging in size between 36-57 mm (1.4 to 2.2 inches) were captured and released downstream (Table 5-15). The first rainbow trout/steelhead was captured on May 17. The remaining five rainbow trout/steelhead were captured during a one week period from June 1-6. The physiological state (relative to smoltification) of these fish was not determined. Other fish species captured included arroyo chub, stickleback, fathead minnow, and sculpin.

Table 5-15. Record of rainbow trout/steelhead captured in traps in tributaries of the Lower Santa Ynez River.A1

Hilton Creek

UPSTREAM MIGRANTS

	Date	Length	Fish #	Sex	Genetic Type
1994	21-Feb	430	N/A	N/A	
	21-Feb	450	N/A	N/A	
1995	20-Jan	440	1	?	
	30-Jan	450	2	?	
	31-Jan	270	3	?	
	1-Feb	283	4	?	
	1-Feb	355	5	?	
	1-Feb	435	6	?	
	2-Feb	387	7	F	
	2-Feb	365	8	F	
	2-Feb	384	9	?	
	2-Feb	384			
	4-Feb	379	10	M	
	7-Feb	356	11	F	
	7-Feb	285	12	?	
	8-Feb	457	15	?	
	8-Feb	380	16	?	
	8-Feb	375	17	?	
	8-Feb	444	18	?	
	8-Feb	406	19	?	
	8-Feb	406	20	?	
	17-Feb	470	21	F	
	20-Feb	375	22	F	
	5-Mar	520	23	F	
	5-Mar	387	24	?	
	8-Mar	425	25	M	
	9-Mar	404	28	F	
	9-Mar	385	29	F	
	17-Mar	383	30	F	
	20-Mar	285	33	M	
	20-Mar	403	34	F	
	20-Mar	371	35	M	
	20-Mar	377	36	F	
	20-Mar	362	37	F	
	21-Mar	315	38	M	
	22-Mar	381	39	F	
	22-Mar	386	40	M	
	22-Mar	335	41	?	
	25-Mar	423	42	F	
	29-Mar	385	43	F	
	4-Apr	359	44	F	
	7-Apr	442	45	F	
	12-Apr	407	47	F	
	13-Apr	408	49	M	
	13-Apr	366	50	M	
	16-Apr	386	52	F	
	20-Apr	400	53	F	
	21-Apr	385	54	F	
	22-Apr	400	55	F	
	22-Apr	380	56	M	
	22-Apr	360	57	F	
	23-Apr	390	58	F	
	29-Apr	400	59	M	
	3-May	410	60	F	
	3-May	400	61	F	

DOWNSTREAM MIGRANTS

	Date	Length	Fish #	Sex	Genetic Type	Smolt
1995	8-Feb	406	13	M		
	8-Feb	368	14	F		
	8-Mar	360	27	?		
	18-Mar	379	31	M		
	7-Apr	447	46	F		
	9-Apr	425	48	F		
	13-Apr	395	51	M		
	10-May	389	62	F		
	10-May	395	63	M		
	10-May	385	64	F		
	11-May	390	65	F		
	11-May	360	67	F		
	19-May	397	69	?		
	29-May	360	68	F		

Table 5-15. Record of rainbow trout/steelhead captured in traps in tributaries of the Lower Santa Ynez River.A1

Salsipuedes Creek

UPSTREAM MIGRANTS						DOWNSTREAM MIGRANTS						
	Date	Length	Fish #	Sex	Genetic Type		Date	Length	Fish #	Sex	Genetic Type	Smolt
1994	3/11/94	320	N/A	N/A		1994	1-Jun	46	N/A	N/A		N
							3-Jun	38	N/A	N/A		N
							3-Jun	44	N/A	N/A		N
							6-Jun	57	N/A	N/A		N
							6-Jun	36	N/A	N/A		N
							18-Dec	88	N/A	N/A		N
							27-Dec	90	N/A	N/A		N
							28-Dec	93	N/A	N/A		N
							29-Dec	92	N/A	N/A		N
1995	20-Feb	368	S-1	?		1995	10-May	185	S-3	N/A		
	20-Feb	362	S-2	?			31-May	155(45.1g)	S-4	N/A		
1996	14-Feb	355	SU-1	?		1996	6-Feb	132(35.6g)	SD-1	N/A		?
	1-Mar	345	SU-2	?			18-Mar	187(N/A)	SD-2	N/A		?
							15-Apr	153(37.5g)	SD-3	N/A		y
							18-Apr	131(23.0g)	SD-4	N/A		y

Alisal Creek

UPSTREAM MIGRANTS						DOWNSTREAM MIGRANTS						
	Date	Length	Fish #	Sex	Genetic Type		Date	Length	Fish #	Sex	Genetic Type	Smolt
1995	30-Jan	375	A-1	?								
	3-Feb	385	A-2	F								

Morning water temperatures at the trap location from April to June ranged between 13.6 C and 17 C. Water temperatures became moderately warmer as the day progressed. The highest recorded temperature 23 C and occurred on June 10, 1994. However, most late afternoon temperatures from April to June ranged between 17 and 20 C.

The downstream migrant trap was re-deployed at the same location on October 20, 1994 to capture rainbow trout/steelhead that may be migrating out of Salsipuedes Creek and into the Santa Ynez River at the beginning of the rainy season. Between December 18 and December 29, 1994 four rainbow trout/steelhead ranging in size between 80-93 mm were captured and released downstream. Some darkening of the caudal fin and dorsal fin was observed, however, the fish were lacking the silver coloration indicative of smolting and were instead very colorful with visible parr marks.

The trap was fished in the same location in 1995. Two downstream migrating smolts were captured on May 10 and May 31, 1995. Both fish exhibited external indications of smoltification (silver coloration, deciduous scales). The smolts measured 185 mm (7.3 inches) and 155 mm (6.1 inches). These fish indicate the presence of anadromous traits (smolting) within the rainbow trout/steelhead population inhabiting the Salsipuedes Creek drainage.

In 1996 four rainbow trout/steelhead were captured in the downstream trap (Table 5-15). Two of these exhibited evidence of smoltification. They were captured on April 15 and April 18 and were 131 mm (5.2 inches) and 153 mm (6.0 inches) in length. Two other juvenile rainbow trout/steelhead were captured on February 6 and March 18 and were 132 mm (5.2 inches) and 187 mm (7.4 inches) in length, respectively.

Fish Distribution and Abundance

A reconnaissance level walking survey of Salsipuedes Creek was conducted on May 4, 1994 from Highway 1 Bridge #51-95 upstream to El Jaro Creek (SYRTAC 1994). El Jaro Creek was surveyed from the Salsipuedes confluence upstream two miles, and another quarter mile section of Salsipuedes Creek was surveyed upstream of the confluence with El Jaro Creek.

Arroyo chub, fathead minnows, and stickleback were abundant in all habitats, especially pools in the lower sections of the creek. Several rainbow trout/steelhead were observed in the area of the confluence of Salsipuedes and El Jaro creeks. Trout were also observed in the lower parts of El Jaro Creek and two possible rainbow trout/steelhead redds were seen. In upper reaches of El Jaro Creek no rainbow trout/steelhead were observed even though some reaches had excellent spawning and rearing habitat. In addition, other fish (i.e., arroyo chub, stickleback) were greatly reduced when compared to the lower sections.

Electrofishing surveys were also conducted in 1994. Eighteen habitat units (6 riffle, 6 run, and 6 pools) were sampled by electrofishing on May 24-26 1994 and again on August 16-17, 1994 at the confluence area of Salsipuedes and El Jaro Creeks. During both surveys, nine habitat units were sampled upstream of the confluence in El Jaro Creek; another six units were sampled in Salsipuedes Creek, above the confluence with El Jaro Creek; and an additional three units were sampled below the confluence with El Jaro Creek in Salsipuedes Creek.

Young-of-the-year rainbow trout/steelhead, ranging in size from 35-55 mm (1.4 to 2.2 inches) were captured during May. Juvenile and adult rainbow trout/steelhead were also captured, with lengths ranging between 100-300 mm (3.9-11.8 inches). In August surveys, young-of-year rainbow trout/steelhead typically ranged in size between 60-80 mm (2.4 to 3.1 inches). Juvenile rainbow trout/steelhead or resident rainbow trout/steelhead between 100 and 300 mm (3.9 to 11.8 inches) were again present. Only one fish larger than 250 mm (9.8 inches) in length was observed and it was seen in Salsipuedes Creek upstream of the confluence with El Jaro Creek.

Mean length of young-of-year rainbow trout/steelhead was 25 mm greater in August compared to the May surveys. Although growth undoubtedly occurred during this period, differences in mean length could also be related to differential size-related mortality and/or migration. All size classes of rainbow trout/steelhead were in robust condition and were observed to have good coloring. Water temperatures were slightly warmer during the August survey.

In May surveys, juveniles appeared to be more abundant in El Jaro Creek than in Salsipuedes Creek above the confluence but abundance in August appeared similar. In August all rainbow trout/steelhead were found in pools though young-of-year continued to be found in riffles and runs as well as pools.

In qualitative surveys conducted in 1996 young-of-year and larger rainbow trout/steelhead up to approximately 10 inches were widespread in surveyed sections of Salsipuedes and El Jaro creeks (Ed Ballard, USFWS, November, 1996, personal communication).

A spawning survey was conducted in Salsipuedes and El Jaro Creeks between April 3 and April 8, 1996. Three redds were identified in the section between Santa Rosa Road and the Salsipuedes-El Jaro confluence. Seven redds were identified in Salsipuedes Creek upstream of the confluence, and seven were identified in El Jaro Creek, all within a quarter-mile of the confluence. Redd dimensions and velocity characteristics were recorded (Table 5-16).

Nojoqui Creek

A reconnaissance-level walking survey of Nojoqui Creek was conducted on May 5, 1994 below Bridge #51-74B, just off Highway 101 approximately four miles south of the City of Buellton (SYRTAC 1994). The survey continued in a downstream direction until the confluence with the Santa Ynez River was reached. No rainbow trout/steelhead were observed during the survey, nor were other fish species reported.

Electrofishing and snorkel surveys were conducted in Nojoqui Creek on May 27, 1994 to determine if rainbow trout/steelhead were present. Approximately 500 m (1640 feet) of the creek was electrofished in riffles, runs, and shallow pool areas where young-of-year rainbow trout/steelhead might be found. Deeper pool areas where over-summering rainbow trout/steelhead might be found and where electrofishing is generally less effective, were sampled visually in snorkel surveys. No rainbow trout/steelhead were observed or captured using either method. A few pools had small populations of green sunfish and largemouth bass. Abundant populations of arroyo chub and stickleback were observed in all habitat areas.

An upstream migration trap was fished in Nojoqui Creek in 1995 between February 25 and April 24. No rainbow trout/steelhead were captured. A downstream migrant trap was also fished in 1995 from March 29 to April 24. No rainbow trout/steelhead were captured. Due to low streamflow the traps were only functional 33 days during the period.

Table 5-16. Redd dimension and current velocity (ft/sec) for rainbow trout/steelhead redds in Salsipuedes and El Jaro Creeks, (April 8 and 25, 1996).

Redd #	Head velocity (ft/sec)	Pit velocity (ft/sec)	Length (feet)	Width (feet)
Salsipuedes Creek				
1	.97	.88	3.0	2.0
2	.97	.91	1.6	1.6
3	1.23	1.45	2.8	1.7
4	.57	.63	3.0	1.8
5	2.58	1.53	4.0	2.0
6	2.08	1.76	6.0	2.5
7	.67	.59	2.0	1.5
El Jaro Creek				
1	.76	.93	2.8	1.7
2	1.19	.86	5	2.3
3	.97	.83	2.7	2
4	.68	.87	3	1.8
5	.87	.81	4.5	2.2
6	.82	.55	3.5	2

Alisal Creek

An upstream migrant trap was operated in Alisal Creek during a brief period in January and February 1995. The stream had previously been blocked to upstream migration of rainbow trout/steelhead by a concrete structure just upstream from the confluence with the Santa Ynez River. The structure washed out of the stream during high flows in early January 1995. A reconnaissance level electrofishing survey was conducted upstream of the impoundment at Alisal Dam in 1995. No other surveys have been conducted in Alisal Creek.

The upstream migrant trap was located approximately 150 m upstream from the confluence with the Santa Ynez River. It was deployed on January 18, 1995 and removed on February 7, 1995 at the request of the land owners. It was also removed from the stream between January 26 and 29 during a storm event but was re-deployed after high flows receded. Two adult rainbow trout/steelhead, measuring 14.8 and 15.2 inches, were captured in the Alisal Creek trap on January 30 and February 2. Flow was estimated at 10-15 cfs and the water clarity was good at time of capture. One fish was a female, the sex of the other could not be determined. Both fish were in robust condition and were released upstream of the trap.

Electroshocking surveys were conducted in Alisal Creek upstream of a small impoundment two to three miles upstream of the Santa Ynez River confluence. A brief, qualitative survey was conducted on February 1, 1995. A total of 20 rainbow trout/steelhead were measured and ranged in length from 78 to 235 mm (3.1 to 9.2 inches) (Figure 5-6). Trout in the smaller size classes (70-120 mm) appeared to be under-represented but firm conclusions can not be drawn because surveys were not extensive and were not quantitative. Tissue samples were taken from these fish for genetic analysis. Weights and condition factors were not recorded but fish appeared to be in good condition.

Quiota Creek

An upstream migrant trap was fished in Quiota Creek from February 2 to February 22, 1995 (Table 5-1). The trap was not functional for two days due to high flows. No migrating fish were captured in Quiota Creek but in early February 1995, two potential redds and two rainbow trout/steelhead (15.7 and 7.0 inches in length) were seen in Quiota Creek near the downstream trap.

A reconnaissance level walking survey of Quiota Creek was conducted on May 5, 1994 (SYRTAC 1994). The sections of creek immediately upstream and downstream of the Refugio Road bridge at its first crossing south of the Santa Ynez River were surveyed. Aquatic habitat was degraded (Section 4.3) and no fish were observed in any portion of the stream.

A tributary to Quiota Creek was sampled on August 2, 1994. This unnamed tributary enters Quiota Creek roughly four miles upstream from the Santa Ynez River confluence. The tributary was spring fed and had little to no flowing water at the time of the survey. Most of the aquatic habitats were produced by upwelling. A 150 m (490 foot) reach was spot electrofished to identify overall numbers and sizes of rainbow trout/steelhead, and to evaluate their condition.

The tributary creek was located within a steep gully with little riparian vegetation, however, it had a large amount of boulder cover and adequate pool depth in some places to provide refuge for rainbow trout/steelhead. Canopy in the form of large oaks and cottonwoods shade a significant portion of the creek.

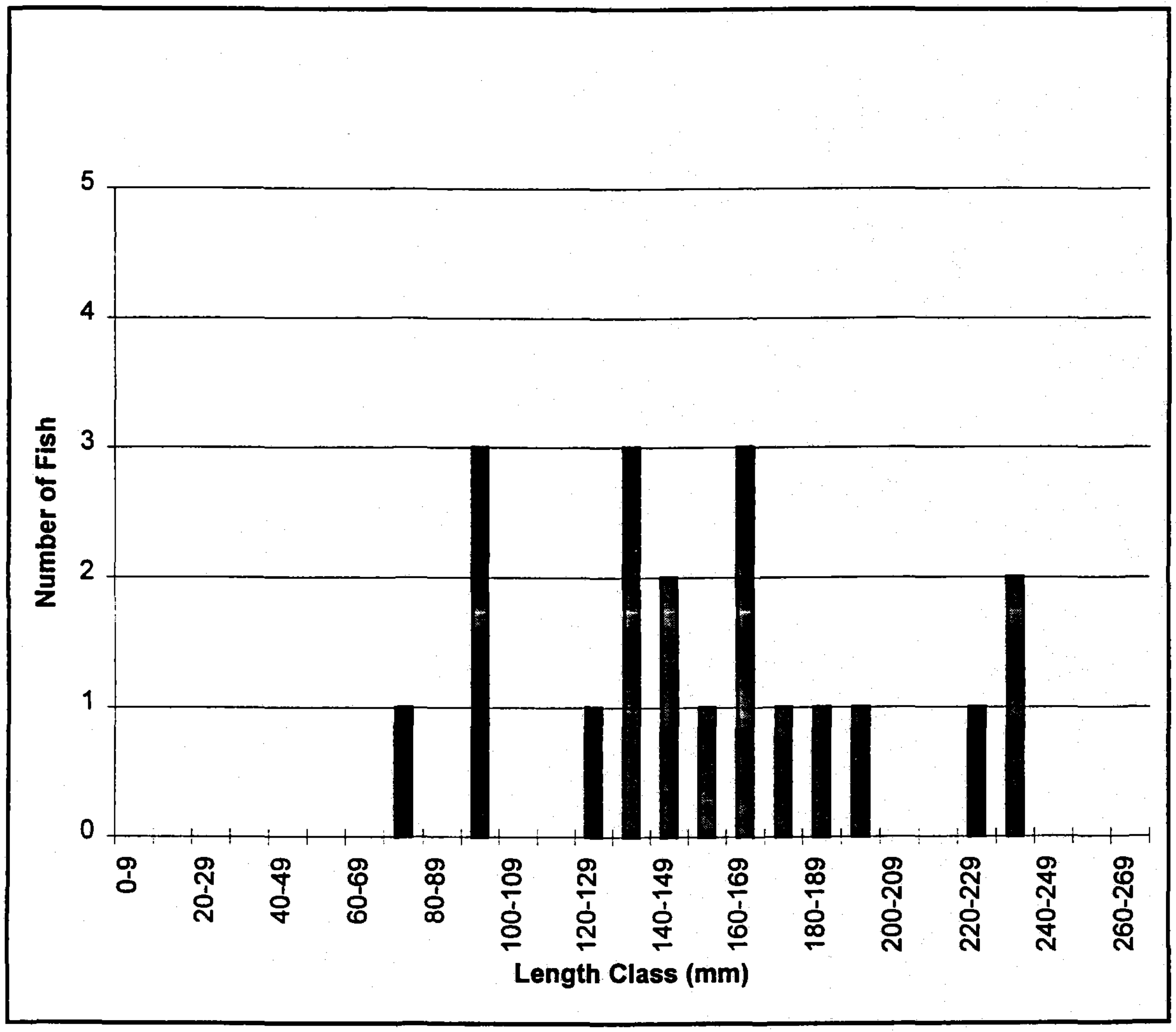


Figure 5-6. **Length distribution of rainbow trout/steelhead from Alisal Creek in February, 1995.**

Water quality parameters were measured at 9:30 am as follows:

Air Temperature	15.5 C
Water Temperature	14.5 C
Conductivity	820 mmhos
Dissolved Oxygen	7.6 mg/l

Thirteen rainbow trout/steelhead were captured ranging in size from 51-221 mm (2.0 to 8.7 inches). Three of the captured fish were young-of-year: 51, 70, 71 mm in length (2.0, 2.8, and 2.8 inches). Six were between 165-199 mm (6.5 to 7.8 inches) and the other four were between 202-221 mm (8.0 and 8.7 inches). In visual observations of parts of the reach not sampled there were at least 100 additional young-of-year rainbow trout/steelhead and another 20-30 juvenile/adults. All rainbow trout/steelhead captured appeared healthy on gross external examination, were very colorful, and had no eroded or clubbed fins. This population of rainbow trout/steelhead is believed to be self-sustaining. Scale and tissue samples were not taken.

Hilton Creek

Studies in Hilton Creek have involved operation of an upstream migrant trap beginning in the fall of 1993 and operation of a downstream migrant trap beginning in the spring of 1995 (Table 5-1). Incidental observations during the spawning season have also been made. Studies have been limited to the lower half-mile of the Creek from the confluence with the Santa Ynez upstream to the Bureau of Reclamation property line. Surveys for resident fish, fish habitat, and spawning activity have not been conducted in the upper part of the creek.

Trapping surveys for migrating adult rainbow trout/steelhead were initiated during the winter of 1993-94. Of all tributaries where trapping has been conducted, Hilton Creek was the easiest due to its relatively stable substrate and constricted, boulder influenced channel. Even so, the flashy nature of the drainage created debris and trap washout problems during each storm event.

Adult rainbow trout/steelhead have entered Hilton Creek to spawn during the winters of 1993-94 and 1994-95. Hilton Creek flowed for only a few days during the winter of 1995-96, but three trout migrated in before the trap was deployed.

During the 1993-94 season the trap was in place from January 19 through April 21 although there were only brief periods when the stream actually flowed at the trap location. The trap was washed out by high flows on February 20 but was replaced the next day. Two rainbow trout/steelhead (measuring 17 and 18 inches in length) were captured, both on February 21, as the high flow receded (Table 5-15). Several other fish apparently moved past the trap location when the trap was disabled since several large rainbow trout/steelhead were captured above the trap site after the high flow receded. These fish were moved by CDFandG personnel to the mainstem Santa Ynez River. The two fish captured in the trap appeared to be in good health. No scale samples were taken and no tissue was taken for genetic analysis but photographs were taken of both fish. The adult rainbow trout/steelhead migrating into Hilton could have entered the lower Santa Ynez River either from the ocean or in releases from Cachuma Reservoir. Alternatively, they could be fish that were resident in the river, its tributaries, or the lagoon at the mouth of the river.

Trapping was resumed in Hilton Creek on January 16, 1995 (Table 5-1). A total of 52 rainbow trout/steelhead migrated upstream into the trap or were netted upstream of the trap with 28 percent trapped in February, 37 percent in March, and 35 percent in April. Hilton Creek fish ranged in size from 14 to 20.5 inches (Table 5-15). The actual number of fish entering Hilton Creek was probably much greater since all fish captured on their way upstream were marked (right pectoral fin clipped), but only four of sixteen fish captured on their return downstream were marked. Unmarked fish went upstream during periods when the trap was not operational or ineffective due to high streamflow. Adults returning downstream were captured in February (12 percent), March (19 percent), April (19 percent), and May (50 percent). Hilton Creek went dry in the study area in early August 1995.

Trapping in 1996 was re-initiated in Hilton Creek on February 23. Hilton Creek only flowed briefly after precipitation in late February and the trap was only fished for three days. No fish were captured in the trap, but three rainbow trout/steelhead entered the creek before the trap was deployed. Flows receded quickly, and the fish were stranded within a week. Two of these were captured and moved, the third disappeared.

It is not known whether any production occurred from the rainbow trout/steelhead entering in the winter of 1993-94 since surveys for young-of-year were not conducted in the spring or summer of 1994. No young-of-year or juvenile rainbow trout/steelhead were observed in Hilton Creek or in the Santa Ynez River near the confluence with Hilton Creek in incidental observations by Entrix that spring. Hilton Creek reportedly went dry by late May in 1994 (Entrix, 1995).

Fish entering Hilton Creek in the winter of 1994-95 reproduced successfully. Young-of-the-year were abundant in Hilton Creek in the spring and early summer of 1995 and were also seen in the mainstem in the Highway 154 reach. During a snorkel survey in April a total of 224 young-of-year were observed from the confluence to the upper Shute Pool (about 1200 feet). A total of 25 adults were also observed. By May, the numbers of young-of-year were visually estimated at one thousand. In early August the lower reaches of Hilton Creek were going dry and young-of-year rainbow trout/steelhead were captured by seining in the single remaining pool in the upper part of the study section. These fish were relocated to the mainstem Santa Ynez River. Length of 73 of these fish ranged from 2.0 to 5.5 inches and averaged 2.9 inches (Figure 5-7). Some of the larger fish (e.g. 4.7, 5.2, and 5.5 inches) may have been from the previous years spawning and may have come from further upstream. Condition factors for the 73 fish ranged from 0.67 to 1.55 and averaged 1.16. Both length and condition factors are within the range expected for healthy populations of rainbow trout/steelhead except for the one young-of-year fish with a condition factor of 0.67.

San Miguelito Creek

San Miguelito Creek flows north out of the Lompoc Hills, through the town of Lompoc, and into the Santa Ynez River between 13th Street and Floradale Avenue. The creek flows into a settling basin near 'O' Street and Olive Avenue in Lompoc, and does not flow to the Santa Ynez River, except during high winter flows.

On July 8, 1996 a brief survey was conducted at three locations in San Miguelito Creek. Observations were made from the bank and in qualitative snorkel surveys. At the first location (approximately two miles from Lompoc), observations from the bank indicated the presence of several (5-10) small fish, presumed to be young-of-year rainbow trout/steelhead.

Snorkel observations were made at San Miguelito Park (approximately three miles from Lompoc). Approximately 200 young-of-year were observed in a quarter mile section of the creek. In addition, several larger rainbow trout/steelhead (between 4-11 inches) were observed in deeper pool habitats.

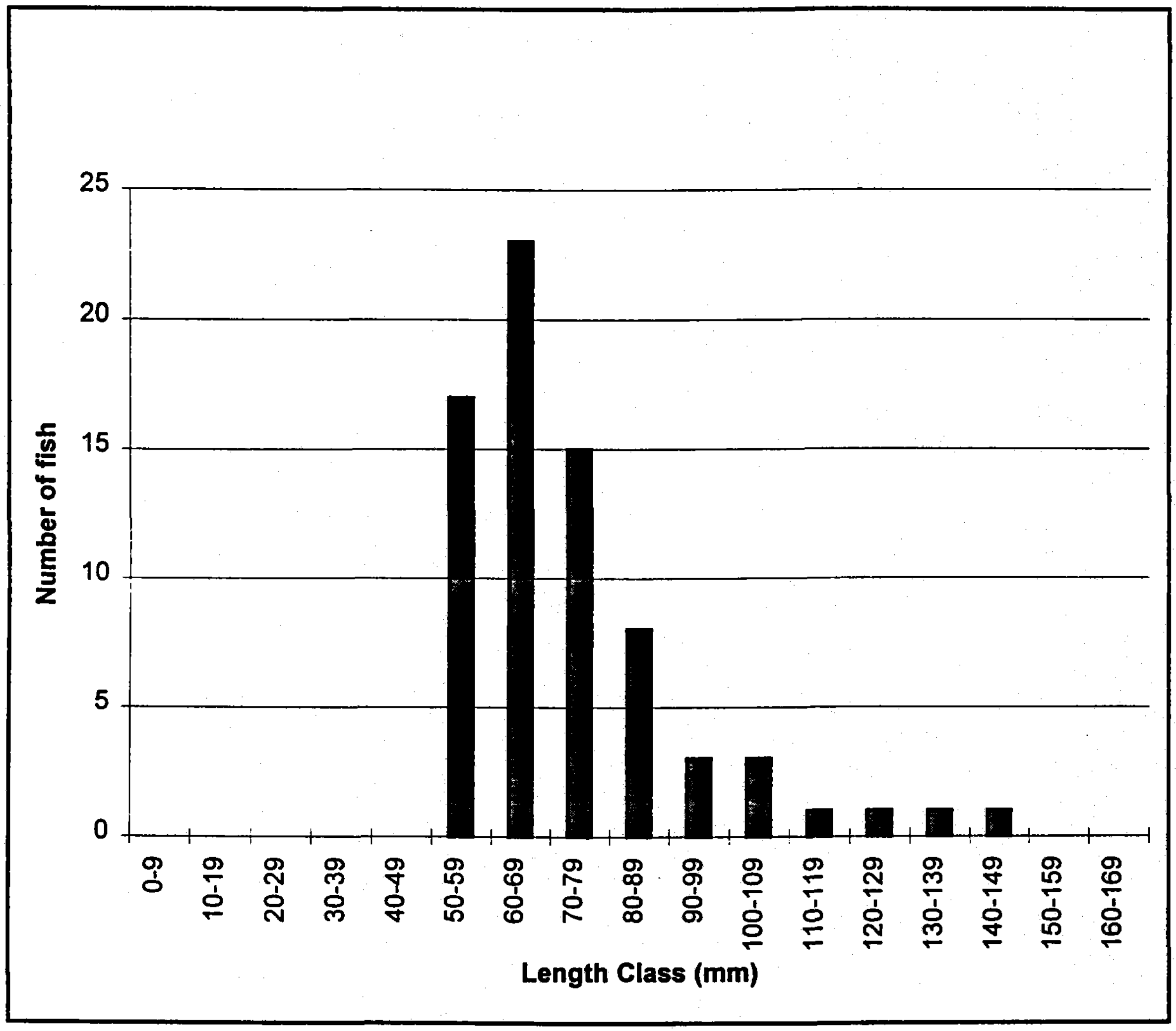


Figure 5-7. **Length distribution of rainbow trout/steelhead in Hilton Creek in August, 1995.**

A brief walking survey was conducted in a short (200 yard) section, approximately five miles from Lompoc. A passage barrier exists in this section of the creek. One small rainbow trout/steelhead (approximately four inches), was observed downstream of the passage barrier. No fish were observed upstream of the barrier.

Estimated flow at the time of the surveys was about 1.0 cfs. Good canopy and riparian vegetation was observed throughout the areas surveyed. Some cattle impacts were observed one quarter mile upstream of San Miguelito Park. Few pool habitats (less than five) were observed in the sections surveyed, with the majority of habitat in runs and riffles. Creek substrate was composed mainly of gravel and cobbles which did not appear to be embedded. The crew identified three upstream passage barriers.

5.4 Rainbow Trout/Steelhead Stock Origin

Stock origins of rainbow trout/steelhead collected in the lower Santa Ynez River were evaluated by Entrix (1995) and their findings are paraphrased here. Nielsen (1994) used sequencing of mitochondrial DNA (mtDNA) on 547 coastal steelhead from 33 streams and five hatcheries throughout California, and identified fourteen "mtDNA types" within California populations. Of these, four types appear to predominate in coastal steelhead populations (referred to as Type 1, Type 3, Type 5 and Type 8). Rainbow trout/steelhead of all of these types were found inhabiting the Santa Ynez River below Bradbury Dam (Table 5-17). Two additional types, 10 and 14, were also identified in Santa Ynez River stocks. Nielsen (1994) found that although each of the four main types (1, 3, 5, 8) were found throughout coastal California, these demonstrated a distinct bio-geographical frequency distribution cline along the coast. For example, Type 1 fish were far more common in northern California streams (Humboldt Bay to Gualala Point) than they were in streams to the south, while Type 3 fish were the most common variety between the Russian River and Point Sur (Nielsen, 1994). The frequency of occurrence of Type 5 fish increased in streams south of San Francisco, and Type 8 steelhead were found predominantly in southern California rivers (from San Simeon Point to Santa Monica Bay) (Nielsen *et al.*, 1994). Types 1 and 3 are also common in several hatchery strains, and have been widely introduced throughout California. Type 10 steelhead also appear to indicate hatchery stock descent. Only two Type 14 steelhead/rainbow were identified by Nielsen (as cited by Entrix, 1995), and therefore the distribution of this type is unclear. "Nielsen *et al.* (1994) founds types 10 and 14 only once in California, and then in southern California streams (Nielsen *et al.*, 1994). More recent analysis (J. Nielsen, pers. comm., 1996) revealed type 10 fish, but no type 14 fish, in several hatchery strains, including strains commonly stocked in southern California. Type 10 has been found in Canadian rainbow trout/steelhead, and type 14 is phylogenetically similar to type 10. This suggests that type 14 may also have a more northerly origin, but sample sizes are far too small for conclusions."

Nielsen (1994) has suggested that oceanic conditions may contribute to the distribution of southern steelhead lineages found in her study. Ocean currents and nutrient availability patterns may result in smolts remaining in southern California waters (the northern edge of the southern California genotypes runs from near Point Conception south). However, some movement of steelhead from north to south was evident from Nielsen's work.

DNA sequencing only requires very small amounts of tissue. MtDNA sequencing analysis was performed on 41 rainbow trout/steelhead inhabiting the Santa Ynez River basin to determine the stock origins for these fish (Nielsen as cited in Entrix, 1995). The mtDNA sequencing analyses were conducted according to the methods described in Nielsen (1994). Tissue samples from 23 rainbow trout/steelhead from Salsipuedes and El Jaro creeks (collected in 1994), three from the Santa Ynez River (collected in 1994) and six from Hilton Creek (collected in 1993) were

Table 5-17. Mitochondrial DNA type frequencies among rainbow trout/steelhead collected from the lower Santa Ynez River Basin. *After Swenson, 1996.*

Study	Location	Year Collected	Life Stage	mtDNA types										Total
				1	3	5	6	8	9	10	12	13	14	
Nielson *et* al., 1994	Above Juncal Dam	1990-93	Juvenile/YOY or 1 +	3	1	12	5	18	4		4	8		55
Nielson *et* al., 1994	Hilton Creek		Juvenile/YOY or 1 +	1										1
Entrix 1995	Salsipuedes & El Jaro Creeks	1994	Juvenile			12		11						23
Entrix 1995	Hilton Creek 1995	1993	Adult	1	2			1		1			1	6
Entrix 1995	Santa Ynez River	1993-94	Adult	1		2								3
Entrix 1995	Lake Cachuma	1993		3	3	1		2						9
	All Santa Ynez Basin			9	6	27	5	32	4	1	4	8	1	97

analyzed. Rainbow trout/steelhead from Salsipuedes and El Jaro creeks ranged in length from two to nine inches, while the Santa Ynez River fish were approximately 16 to 17 inches long. The rainbow trout/steelhead from Hilton Creek were all adults (greater than 12 inches in length). Finally, nine rainbow trout/steelhead from Lake Cachuma (collected in 1993) were also analyzed.

Following the classification scheme presented in Nielsen (1994), the rainbow trout/steelhead from Salsipuedes and El Jaro creeks were all sequenced as Type 5 (12 fish) and Type 8 (11 fish). These types were more common in Southern California populations (Table 5-17).

In 1993, streamflow below Bradbury Dam was sufficient for adult steelhead to migrate from the ocean to Hilton Creek. The six rainbow trout/steelhead collected from Hilton Creek were classified into five types, Type 1 (one fish), Type 3 (two fish), Type 8 (one fish), Type 10 (one fish), and Type 14 (one fish).

Three rainbow trout/steelhead were collected in the Santa Ynez River between December 1993 and April 1994, when low streamflow would have prevented upstream migration by adult steelhead from the ocean. Two of the rainbow trout/steelhead found in the Santa Ynez River were sequenced as Type 5, while the third Santa Ynez River fish was identified as a Type 1 (Table 5-17). Two of the Santa Ynez River fish were found in or near the long pool (a Type 5 and the Type 1), while the third was found near Solvang (Type 5). Of the nine rainbow trout/steelhead from Lake Cachuma, six (three each) were either Type 1 or Type 3, and three fish were either Type 5 (one fish) or Type 8 (two fish).

There are at least three potential paths by which "northern rainbow trout/steelhead" stocks (e.g., Types 1 and 3) could invade the Santa Ynez River: 1) stocking of hatchery fish into Lake Cachuma; these can include recent introductions or fish that have been resident for a longer period; 2) stocked rainbow trout/steelhead that reverted to an anadromous life history strategy and are successfully reproducing in the river and/or tributaries below Bradbury Dam; and 3) strays from northern California rivers. Stocked rainbow trout/steelhead can move downstream from Lake Cachuma during years when the reservoir spills (e.g., 1993). There are at least four potential scenarios for "southern California rainbow trout/steelhead" found in the Santa Ynez River below Bradbury Dam: 1) anadromous adults returning to their natal stream(s); 2) strays from other river systems; 3) resident (residualized) fish surviving in the pools below the dam; and/or 4) fish produced in streams above the dam moving downstream.

Stock identification based on mtDNA sequencing can not determine the life history strategy (i.e., resident or anadromous) of the rainbow trout/steelhead tested. On the basis of Nielsen's work, it does show that the rainbow trout/steelhead inhabiting Salsipuedes and El Jaro creeks are most likely of southern California lineage. Salsipuedes and El Jaro creek rainbow trout/steelhead have access to the ocean more frequently than areas upstream.

Tissue samples are taken from rainbow trout/steelhead captured in SYRTAC migrant traps for the purpose of expanding on the genetic analysis conducted to date. In addition, observations of fin condition are recorded for all captured fish. Since rainbow trout/steelhead of hatchery origin often have abraded or missing fins this information, in conjunction with genetic testing and other data may be useful in addressing issues of stock origin of Santa Ynez River fish. Table 5-18 provides a summary of observations of fin condition of fish collected to date.

Table 5-18. Fin condition of rainbow trout/steelhead captured in SYRTAC migrant monitoring traps (H- prefix is Hilton, A- is Alisal, S- is Salsipuedes).

Fish #	Description
H-10	Clubbed pectorals
H-13	Worn from spawning
H-15	Fins in good condition
H-17	Fins in good condition. Deep puncture wound on right side
H-18	Missing dorsal soft fin rays
H-19	Fins in good condition
H-20	Fins in good condition
H-21	Fins in good condition
H-22	Paired fins in good condition. Clubbed caudal fin
H-23	Fins in good condition
H-24	Left pectoral clipped
H-25	Fins in good condition
H-28	Fins in good condition
A-2	Fins in good condition
S-1	Right pectoral and caudal clubbed
S-2	Right pectoral partial clubbed
H-29	Left,Right, and dorsal clubbed
H-30	Right pec. clipped, dorsal fin eroded, upper and lower lobes of caudal worn
H-31	Caudal and dorsal highly eroded
H-32	Fins in good condition
H-33	All fins clubbed
H-34	Caudal, anal, and right pelvic clubbed
H-35	Dorsal clubbed. All fins in good condition. Right pec. frayed
H-36	Right pec. gone, left pec. clubbed
H-37	Left pec. slightly frayed. All fins in good condition
H-38	All fins clubbed or eroded
H-39	All fins in good condition
H-40	All fins clubbed or erroded

H-41	All fins clubbed or eroded
H-42	Dorsal eroded and clubbed, all other fins in good condition
H-43	Both pec. fins show past clubbing
H-44	All fins except dorsal clubbed
H-45	Right pec, dorsal, and small portion of lower caudal clubbed
H-46	All fins in good condition
H-47	All fins in good condition
H-48	All fins in good condition except for some recent fraying
H-48	All fins in good condition
H-49	All fins in good condition
H-50	Dorsal and caudal clubbed
H-51	Fish in poor condition
H-52	Dorsal clubbed, left pec torn or clipped, dorsal almost completely worn off
H-53	All paired fins in good condition, dorsal slightly clubbed
H-54	All fins in good condition
H-55	All paired fins in good condition, dorsal slightly clubbed
H-56	All fins in good condition
H-57	Right pectoral clubbed
H-58	Right pec and dorsal clubbed
H-59	Dorsal and right pec clubbed
H-60	All fins in good condition
H-61	Right pec and dorsal clubbed

Fish in which no description was recorded are not included in this table. Only fins that are missing or clubbed are recorded. All other fins are in good condition unless otherwise stated.

5.5 Summary

- The Santa Ynez River downstream of Bradbury Dam supports fluctuating and transient populations of fish. The most abundant species are those that have tolerance for widely fluctuating conditions of streamflow, temperature, and dissolved oxygen. The fish community in larger, deeper pools was dominated by introduced species, including largemouth and smallmouth bass, green sunfish, bluegill, redear sunfish, channel catfish and bullheads, species preferring warm, non-flowing aquatic habitats. Largemouth bass, in particular, reproduce successfully and are abundant in the river below Bradbury Dam. Bass fry were observed in the long pool in May 1994, from August through October in 1995, and in 1996. All of the native species reported for the river in the 1940s are still present. The observations of adult and larval Pacific lamprey indicates that, although this species is not abundant, conditions exist that allow for completion of its anadromous life cycle.

- In visual surveys conducted in the Santa Ynez River mainstem in 1995, rainbow trout/steelhead were most abundant in the Highway 154 reach and less abundant in the Refugio reach and Alisal reach. A few surveys in the tributaries indicate that self sustaining rainbow trout/steelhead populations may be abundant in some areas. It is not known whether these were resident or anadromous populations. Surveys have not been conducted in a way that allows easy comparison of population density in the tributaries to that in the mainstem.

- Rainbow trout/steelhead juveniles survived, apparently in healthy condition, in isolated pools in the Santa Ynez River mainstem through the summer and into the fall of 1995 and 1996 in spite of water temperature and dissolved oxygen conditions that exceeded standard tolerance criteria for the species. Survival in these habitats may have been related to upwelling of cool water under low flow conditions, the presence of extensive riparian canopy, reduced abundance of floating algal mats, lack of large predatory fish (largemouth bass), or a combination of these factors. During 1996 trout also persisted in the mainstem after initiation of WR 89-18 releases and loss of thermal stratification in pools. If trout currently inhabiting the Santa Ynez River and/or its tributaries are of native southern steelhead stock, they may be adapted to warmer temperatures than more northern stocks.

- Young-of-year rainbow trout/steelhead were found in the mainstem only in the Highway 154 reach. These are thought to have originated in Hilton Creek since numerous young-of-year were seen in Hilton Creek early in the season. Spawning in the mainstem downstream of Bradbury Dam was not observed but can not be ruled out. Conditions during the spawning season have not been conducive to observation of spawning rainbow trout/steelhead (i.e., high flows and turbid water).

- The tributaries support populations of primarily native species including rainbow trout/steelhead, stickleback, and sculpin though the introduced arroyo chub is also widespread.

- With the notable exception of Hilton Creek, systematic and extensive surveys for spawning rainbow trout/steelhead, or young-of-year have not been conducted in the tributaries. Although extensive spawning has been documented in Hilton Creek, it has also been the area where surveys have been most routine and persistent.

- Salsipuedes and El Jaro creeks support a reproducing population of rainbow trout/steelhead based on the presence of a range of age classes, including young-of-year. The fish appeared healthy, though they were not abundant. Rainbow trout/steelhead redds have also been seen in both Salsipuedes and El Jaro creeks. The capture of juvenile rainbow trout/steelhead exhibiting evidence of smoltification in both 1995 and 1996 indicates the presence of anadromous traits within the population.

- Fish habitat and fish population surveys in the tributaries have not been extensive or routine but, based on the presence of a range of age classes including young-of-year, self-sustaining populations of rainbow trout/steelhead have also been observed in the headwaters of Alisal Creek and a tributary of Quiota Creek. No evidence of rainbow trout/steelhead has been found in the lower sections of Nojoqui Creek but good spawning and rearing habitat exists there. Spawning and the production of young-of-year rainbow trout/steelhead has occurred in Hilton Creek in some years. Lower reaches of Hilton Creek do not provide viable rearing habitat since the stream is frequently dry during summer months. A potential passage barrier a short distance upstream from the mouth may limit or preclude access to the upper reaches of the stream. Numerous young-of-year rainbow trout/steelhead were seen in San Miguelito Creek in 1996.

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SYNTHESIS AND ANALYSIS OF INFORMATION COLLECTED ON THE FISHERY RESOURCES AND HABITAT CONDITIONS OF THE LOWER SANTA YNEZ RIVER: 1993-1996

VOLUME II
APPENDICES

Prepared in Compliance with Provision 2.C of the 1996 Memorandum of Understanding for Cooperation in Research and Fish Maintenance - Santa Ynez River

Santa Ynez River Consensus Committee
Santa Ynez River Technical Advisory Committee

June, 1997

Appendix A

Investigations to Determine Fish - Habitat Management Alternatives for the Lower Santa Ynez River, Santa Barbara County

1996 Long-Term Study Plan

INVESTIGATIONS TO DETERMINE FISH-HABITAT MANAGEMENT ALTERNATIVES for the LOWER SANTA YNEZ RIVER SANTA BARBARA COUNTY

Approved by
SANTA YNEZ RIVER CONSENSUS COMMITTEE

MARCH 1996

EXHIBIT A

PREFACE

Since 1993, the U.S. Bureau of Reclamation, California Department of Fish and Game (DFG), U.S. Fish and Wildlife Service (FWS), and various water project operators have been party to a "Memorandum of Understanding (MOU) for Cooperation in Research and Fish Maintenance" on the Santa Ynez River, downstream of Bradbury Dam ("lower river"). Parties to the MOU maintain a Technical Advisory Committee (TAC) whose ultimate goal is to "develop recommendations for long term fishery management, projects and operations" in the lower river.

The TAC was established in response to State Water Resources Control Board (SWRCB) actions dealing with Bradbury Dam and the lower Santa Ynez River that culminated in the SWRCB requesting flow recommendations for maintenance of public trust resources in the lower river. It was also established to broaden the scope of management options potentially available to protect public trust resources within the lower river, to attempt to accommodate the needs of all interested parties, and ultimately develop mutually acceptable management actions. Since 1993, the TAC has worked from year to year to undertake a variety of studies of the lower river. Over time it has become recognized by all parties and the SWRCB that there is a need for a longer-term study plan that will provide additional technical information to policy makers. The present study plan is intended to serve that purpose.

The waters of the Santa Ynez River are put to a variety of uses, including the maintenance of public trust resources both within Lake Cachuma and downstream of Bradbury Dam, as well as consumptive urban and agricultural uses within the Santa Ynez Valley and along the coastal plain encompassing the City of Santa Barbara and its urban environs. Competition for water from the river among these various uses is the primary impetus for the TAC's existence. Water management, urban encroachment, agriculture, flood control, and gravel mining have all raised concerns over the condition of the public trust resources of the lower river. The existence of these activities has also raised concern about the economic and social impacts of efforts to significantly alter the existing flow regime of the river.

In order to respond to concerns about providing a reasonable balance in the allocation of Santa Ynez River water between public trust resources and competing consumptive uses, as well as between public trust resources within Lake Cachuma and public trust resources downstream of Bradbury Dam, it is important to undertake a series of studies that will provide the technical basis for well-grounded policy decisions. These studies will be devoted to acquiring technical information regarding:

1. The diversity, abundance, and condition of existing public trust fishery resources within the lower river;

2. Conditions which may limit the diversity, abundance, or condition of public trust fishery resources within the lower river;

3. Non-flow measures which could be expected to improve the conditions that currently act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river; and

4. Alternatives to the existing operational regime of the Cachuma Project which could be expected to improve the conditions that currently act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river.

In this regard, it is anticipated that the studies described herein will serve as the technical basis for recommended management of the Santa Ynez River and the Cachuma Project. It is also anticipated that the studies described as part of this plan will help promote a reasonable balance of public trust resources and a secure water supply for the consumptive urban and agricultural users dependent upon Santa Ynez River water. To this end, the studies described herein are designed to develop the information necessary to permit the TAC to recommend measures that will be considered and evaluated by the Consensus Committee to recommend specific management measures to the SWRCB for the purpose of achieving a reasonable allocation of Santa Ynez River water between public trust resources and competing consumptive uses consistent with the goals and objectives outlined below.

GOALS AND OBJECTIVES

STUDY GOAL

The goal of this study is to identify reasonable flow and non-flow measures that will improve habitat conditions for fish populations in the lower Santa Ynez River within the context of overall management objectives and competing demands on the Santa Ynez River.

STUDY OBJECTIVES

The study objectives are to develop technical information concerning:

1. The diversity, abundance, and condition of existing public trust fishery resources of the lower Santa Ynez River;

2. Conditions – habitat quantity and quality, including water quantity and quality – which may limit the diversity, abundance, or condition of public trust fishery resources of the lower river;

3. Non-flow measures which could be undertaken to change existing conditions that act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river; and

4. Alternative flow regimes for the Cachuma Project which could be expected to change the conditions that currently act to limit the diversity, abundance, or condition of public trust fishery resources within the lower river.

MANAGEMENT OBJECTIVES

Identification and evaluation of potential alternative management actions will be based, in part, on the following objectives:

- Improve habitat conditions to maintain fish populations in good condition;
- In particular, protect, maintain, and improve habitat conditions for species listed under the State and Federal endangered species acts or identified as California Species of Special Concern;
- Improve the availability and suitability of stream corridor and channel habitat for a diversity of species of fish and wildlife.

Alternative management recommendations will be developed and evaluated in context with other management objectives for the river. The comparative feasibility of various alternative management actions in achieving these management objectives will be evaluated with respect to the following criteria:

- The proposed management action has a high probability of achieving the desired benefit;
- The management action can be reasonably implemented considering the constraints imposed by natural hydrologic conditions.

BACKGROUND

This study plan has not been developed in isolation. It is part of continuous studies undertaken on the Santa Ynez River and financed by water user interests since 1993. It is anticipated that data acquired as part of those earlier studies will also be used to achieve the study and management objectives described above. Since 1993, these studies have included: (i) water temperature and dissolved oxygen (DO) monitoring in Lake Cachuma and in the lower river from the stilling basin below Bradbury Dam to the lagoon; (ii) habitat quality evaluations in both the lower river and its tributaries; (iii) flow requirements for fish passage in the lower river; and (iv) fish population surveys in both the lower river and its tributaries (SYRTAC 1994, 1995).

Data collected from these studies were analyzed for inclusion in the Cachuma Project Contract Renewal EIR\EIS to describe the status of existing fish resources, existing fish species habitat requirements and conditions, potential factors limiting fish populations, and to allow a comparison of the potential effect of proposed alternatives. A number of analytical techniques used for the preparation of the EIR\EIS are applicable to the current study and may provide a basis for the analytical design.

This proposal promotes the continuation of some of the ongoing investigations, cessation of studies that have already provided sufficient information within the context of this plan, addition of investigations required to augment existing information, and implementation of investigations necessary to support the analytical component of this plan's objectives.

GENERAL APPROACH

The relationship between habitat quality and quantity and instream flow will be determined by integrating channel conditions and fish use information within the framework provided by a flow-habitat model. Fish use will be monitored in various channel conditions, or habitat types, under different flow regimes over a study period of nearly four years. Different flow regimes could result from natural variation in hydrology augmented with Fish Reserve Account releases and potential modifications in routine operations at Bradbury Dam. The Physical Habitat Simulation model (PHABSIM), developed by the FWS (Bovee 1982), will be used to relate fish use and habitat quantity and quality to flow. Consideration is also given in the study plan to continue stream temperature monitoring and modeling in addition to monitoring other water quality parameters such as dissolved oxygen that affect habitat quality.

Fish use and habitat information will be developed using a stratified sampling approach. Strata will be based upon large-scale features such as gradient, substrate and accretion (reaches) and small-scale geomorphological features (habitat types). Habitat types will be selected from each reach to determine function. Similarly, flow-habitat modeling sites will be selected from habitat types based upon function. Surveys of habitat availability and fish use (e.g., species composition, diversity, abundance, condition, and reproductive success) will include both the lower Santa Ynez River main stem and major tributaries.

Based upon results of the fisheries and water quality monitoring proposed as part of this study plan, various alternative management strategies can be developed and the associated biological benefits, operational feasibility and constraints, and potential adverse impacts to public trust resources and water supplies of the Santa Ynez River system can be evaluated. Results of these technical studies will provide the necessary foundation for developing a reasonable and balanced management program for the Santa Ynez River.

STUDY PLAN

JOB 1. Stream reach and habitat inventory

OBJECTIVE: To identify major stream reaches and determine distribution, abundance and quality of mesohabitats(e.g., riffles, pools, etc.) throughout the lower Santa Ynez River.

PURPOSE: This information will be used to systematically subsample habitats within stream reaches for detailed investigation of fish-habitat relationships and to identify habitat quality with the potential for habitat restoration.

PROCEDURES: Two levels of stratification will be used to inventory available habitat throughout the lower main stem. The first level consists of determining the major reaches of the main stem with regard to channel morphology. The TAC has already broken down the main stem into three major reaches for the fish passage study conducted in May 1995. These reaches correspond approximately to those described by Shapovalov (1946) with regard to substrate quality and steelhead/trout spawning: mouth to Salsipuedes Creek, Salsipuedes Creek to Solvang, Solvang to Bradbury Dam, with substrate quality increasing from downstream to upstream. Each tributary[1] should also be broken down into major reaches, e.g. a high-gradient, boulder-controlled upper section vs. a low-gradient, alluvial lower section.

Habitat types will be determined in each reach to achieve the second level of stratification. A modified DFG habitat survey methodology (Flosi and Reynolds 1991) will be used where the principal habitat component is mesohabitat, i.e., pool, riffle, run, etc. Habitat typing of the main stem will be done using the aerial photographs taken in April 1995. Individual habitat units will be numbered from downstream to upstream. While ground truthing selected units, data on habitat attributes will be collected following the instructions in Appendix 1.

SCHEDULE: Habitat typing of the main stem from photographs, and ground truthing of selected units, will be done during March–April 1996.

JOB 2. Habitat function as reflected by fish use

OBJECTIVE: Identify the potential function of available habitats within the mainstem Santa Ynez River and its tributaries with regard to spawning, rearing, migration, species abundance, diversity and spatial and temporal distribution.

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[1] Tributaries included for consideration based upon preliminary survey results dealing with flow and other habitat attributes are Alisal, Hilton, Nojoqui, Quiota, and Salsipuedes-El Jaro creeks.

PURPOSE: This information will be used to locate transects for modeling flow-habitat relationships (PHABSIM) and determine habitat condition including potential for restoration. The migration component will also determine influences of flow and habitat condition on fish movement. Results of these surveys will also provide data on the species composition, abundance reproductive success and condition of the fish populations inhabiting the Santa Ynez River downstream of Bradbury Dam.

PROCEDURES AND SCHEDULES: A table of random numbers will be used to select four pools, and a minimum of three riffles and three runs, from each reach. These units will be sampled systematically to assess their function as spawning and rearing habitat.

Spawning: Selected habitat units will be monitored once a week from December through May, when flow conditions provide for migration and spawning. Units will be checked for spawner use/non-use by looking for spawning activity or recently constructed redds. The location of redds will be marked with rebar and flagging. Water depth and average column velocity will be measured at three locations over undisturbed gravel adjacent to the redd.

Rearing: Abundance estimates will be made for each fish species in each unit once a month. Abundance estimates in pools and runs will be made by direct observation (Helfman 1983), when appropriate. Each unit will be traversed by snorkeling at least twice with a minimum of two observers. Each observer will be assigned a "sample lane," the width of which is dependent on water clarity. Lane width will be determined using the "fish-on-a-stick" method. A 10 cm long facsimile of a fish will be attached to the end of a stick and gradually moved away from the underwater observer until the fish disappears. The distance from the observer to the point where the fish reappears is the maximum lane width. Lane width can be narrower than the maximum if the total habitat unit width is less than the sum of the designated lanes; i.e. (no. observers . maximum lane width) < (total habitat unit width). Observers maintain proper lane width and traverse the habitat, from downstream to upstream, counting fish by species and 25 mm size classes, within their respective lanes. At least two passes will be made with a short (30 minute) interval between passes. To calibrate the direct observation counts (when possible), fish abundance will be estimated in two or more pools per reach and monthly sample period by electrofishing (see below).

The following data will be collected: date; time; reach; habitat number and type; specific location; no. of each species by size class, by pass, and by lane; length of habitat sampled; lane width, maximum lane width (fish-on-a-stick distance), and number of lanes; and duration of each pass. Habitat measurements will be made according to the data sheet in Appendix 1.

Riffles and runs too shallow to snorkel will be sampled by electrofishing.

The habitat unit will be isolated by placing a block net at its upstream and downstream end. The multiple-pass removal method (at least three passes) will be used to make abundance estimates. For each pass, all fish will be counted by species, and all trout will be measured (nearest 0.5 mm fork length, nearest 0.1 g wet weight). Each trout will also be classified by life stage, using the following criteria. *Fry* are newly-emerged fish, typically with at least a vestige of their yolk sac ("unzipped" or not "buttoned up"). *Parr* are darkly pigmented fish with characteristic oval- to round-shaped parr marks on their sides. *Silvery parr* have faded parr marks and a sufficient accumulation of purines in the scales to produce a silvery, but not fully smolted, appearance. *Smolts* have highly faded parr marks, or lack them altogether, a bright silver or nearly white color, and deciduous scales. During November–June, trout will be checked for ripe gonads by applying pressure to the abdomen. If milt or ova are extruded, the corresponding sex of the fish will be recorded. Scales will be collected from all collected trout, up to 10 trout per 25 mm size group per habitat type per sample period. At least two pools per reach and sample period will be sampled by seining or electrofishing to obtain information on individual trout. Any trout killed incidentally will be preserved in 95% ethanol for eventual otolith or other analysis.

Migration: Transect selection and stage and velocity versus discharge data collection to evaluate fish passage conditions were begun in May 1995 at several sites in the main stem where barriers to fish passage likely develop under low-flow conditions. Sites were selected from the aerial photographs taken in April 1995.

Adult and juvenile steelhead/trout movements in relation to flow conditions will be monitored at key locations throughout the lower river system. Two-way trapping will be conducted on the main stem at a suitable location between the lagoon and Solvang; that is, downstream from the predicted primary spawning area. Two-way trapping will also be conducted in Hilton, Salsipuedes, El Jaro, Alisal, Nojoqui, and Quiota creeks. Traps will be installed before 1 January so that the start of both adult immigration and juvenile emigration will be bracketed. Tributaries will continue to be trapped into summer until trout movements cease. A staff gage will be installed near each tributary trap, and discharge will be measured at various flow levels to develop a standard curve. The mainstem trap will be maintained for as long as flow is continuous to monitor trout movement during the rainy season, WR 89-18, and Fish Reserve Account releases.

The following data will be collected: trap name or number; starting and ending date and time of trapping; staff gage elevation; estimated proportion of flow fished by the trap; trout length, weight, life stage, and sex, as described above; counts, lengths and condition of other species by life stage. A portion of the adipose fin will be clipped on all trout during their initial observation in a trap, and subsequent recaptures recorded. Scales will be collected from all adult trout and processed by TAC biological subcommittee representatives to evaluate life-history traits (e.g., growth, migratory history, etc.).

JOB 3. Habitat-flow relationships for spawning, rearing, and migration

OBJECTIVE: Model the relationship between stream flow and habitat quality and quantity for each fish species life-stage function.

PURPOSE: Results of this model will be combined with empirical information on habitat use to develop stream-flow versus habitat availability relationships. These relationships will provide the basis for determining flow requirements for various species-life stages and eventually an important analytical tool for evaluating various management actions, including associated flow regimes and habitat restoration.

PROCEDURES: Survey transects will be established in each habitat unit for modeling flow-habitat relationships using PHABSIM (Bovee 1982). Data will be collected for model building at representative spawning and rearing habitat units under low, moderate, and high flow conditions. Data regarding fish passage were collected at two flow levels during May and June 1995. The same protocol for data collection used at the passage study sites will be used at the spawning and rearing units.

Development of suitability criteria for existing species will be included within the framework of examining habitat-flow relationships. To minimize cost and labor, suitability criteria may be developed by reviewing published criteria for other streams, requesting input from qualified personnel, and by reaching consensus within the TAC. In those cases where consensus cannot be achieved, focused field data collections may be required to resolve differences. Alternatively, a range of suitability criteria sets could be used to bracket conditions and comparative analysis of estimated habitat conditions could be performed.

SCHEDULE: These data collections will occur opportunistically during the ensuing study period as flow conditions allow.

JOB 4. Temperature modeling and dissolved oxygen (DO) monitoring

OBJECTIVE: Model the relationship between temperature and stream flow, channel conditions, and other manageable influences on water temperature. Determine the seasonal and geographical distribution of water temperature and DO for various fish species life stages.

DO monitoring will address three specific problem areas: seasonal DO depressions that may affect the quality of fish habitat in the main stem of the lower river; the extent of diel DO depressions in refuge pool habitat; and determine DO profiles in Cachuma Reservoir that may affect downstream resources through flow releases.

PURPOSE: This information will be used to evaluate various management actions on the temperature and DO conditions within the lower river. Influences of flow regime and habitat/channel restoration will be evaluated relative to achieving water temperature and DO criteria.

PROCEDURES: Data collected to date in the water temperature monitoring network, including temperature profile of Lake Cachuma, will be evaluated. Future data collection will be designed for use in an appropriate temperature model. This model will allow integration of flow, channel geometry, and various other, manageable influences on temperature with meteorological conditions to identify and evaluate potential temperature management actions.

Seasonal trends in DO concentrations will be determined. Two or three long-term monitoring stations will be established in areas with suitable rearing habitat (preferably at existing temperature monitoring stations).

To assess the extent that DO concentrations may be limiting refuge habitat, vertical profiles of DO concentrations will be determined in at least six deep pools downstream of Bradbury Dam (including the stilling basin, the long pool, and habitat units where cool water upwelling has been observed). Temperature and DO will be measured at one-foot intervals and will be conducted quarterly during two time periods: early morning and late afternoon.

Quarterly reservoir DO profiles will also continue to be conducted, along with temperature profiles as previously described.

DO data collected to date, both in Lake Cachuma and in the lower river, will be inventoried and evaluated for their utility in depicting both diel and seasonal trends. Future data collection will be designed, as to the frequency and location of sampling, based on the results of these baseline evaluations.

SCHEDULE: Data collected to date will be evaluated as soon as possible in 1996 following adoption of the long term study plan. Until decided otherwise by the TAC, the water temperature monitoring network and DO monitoring will be maintained as is in the main stem and tributaries on a continuous basis.

JOB 5. Tributary-main stem relationships

OBJECTIVE: Determine habitat use including quantity and quality in tributaries relative to dynamics of the fish populations within the lower river.

PURPOSE: This information will be used to assess the degree to which individual tributaries function as independent steelhead/trout rearing habitats by answering the following questions: Do steelhead/trout spawned in tributaries that typically dry up have a tendency to "escape" to the main stem as stream flow decreases and water temperature increases seasonally (see Erman and Leidy 1975)? Conversely, do those spawned in perennial tributaries remain there to rear until ready to emigrate? Can any significant benefit be gained from flow augmentation in tributaries, such as that proposed for Hilton Creek? How would habitat management activities in the tributaries influence overall management of the lower Santa Ynez River system including influences on flow and other potential modifications in the lower river?

PROCEDURES: The activities described in Job 2 will provide the data necessary to evaluate the habitat use in the tributaries. Trapping will detect the movement of spawners in the stream. Redd monitoring in selected habitat units will determine the location of spawning activity. Snorkeling and electrofishing in the selected habitat units will provide abundance estimates on fry and parr over time as stream flow and water temperature change. Trapping will determine the magnitude and timing of emigration in relation to streamflow and temperature changes. Flow-habitat evaluations in Hilton Creek, the only tributary that potentially could receive flow augmentation, would be evaluated.

SCHEDULE: See schedules under Job 2.

JOB 6. Verification of habitat-flow relationships

OBJECTIVE: Verify streamflow relationships developed in Jobs 3 and 4.

PURPOSE: Determine if the streamflow versus habitat availability/use relationships based upon consideration of flow ranges (Jobs 3) and temperature conditions (Job 4) accurately predict the response in habitat conditions/use.

PROCEDURES: Seasonal, WR 89-18, and Fish Reserve Account releases from Bradbury Dam will be used to empirically verify flow versus habitat relationships identified for target fish species/life stages. The activities described in Job 2 will provide the empirical data necessary to evaluate the response of fish populations to potential changes in flow and temperature conditions. Special study elements (e.g. fish tagging) will be added if needed to answer specific questions.

SCHEDULE: Flow-habitat conditions will be evaluated as soon as practicable after completion of PHABSIM modeling.

JOB 7. Molecular genetic analysis of steelhead/rainbow trout

Tissue samples will be collected from adult rainbow trout/steelhead collected in the upstream trapping program, juvenile rainbow trout/steelhead collected during downstream migration trapping and electrofishing surveys for genetic analysis.

There are a number of analytical methods available that need to be evaluated for appropriateness in addressing specific questions. These methods are currently being researched for review by the TAC. Since the review will not be complete in time for approval of this proposed long-term study plan, a genetic analysis plan component will be included for future evaluation. These samples will be archived until the proper analytical method is determined.

JOB 8. Coordination and collaboration with other study activities

OBJECTIVE: Coordinate TAC studies with other investigations being conducted in the Santa Ynez River watershed, and to incorporate, as appropriate, pertinent data and results.

PURPOSE: Through coordination, eliminate redundancy in efforts, and through collaboration, attain results beyond the scope of the TAC study plan alone.

PROCEDURES: TAC members will gather information on other study activities being conducted in the Santa Ynez River watershed. Study objectives and methods will be compared with those of the TAC's study plan to identify potential duplication of effort or sources of supplemental information. For example, riparian vegetation monitoring along the lower river (mandated in the SWRCB's Water Right Order WR 94-5) may include a habitat mapping element that may overlap or complement that specified in this plan.

Further, the TAC and FWS biologists implementing field data collection will be available to collaborate in activities, with TAC approval, outside the scope of the long term study plan, but which may produce a result of mutual benefit to both TAC study objectives and those of the external agency. Examples are conducting whole or tissue collections of fish for genetics work, such as that being conducted by the Federal government in connection with the steelhead listing process; and DFG-directed management activities in the lower river, such as fish rescues.

SCHEDULE: These activities will be scheduled as they arise.

JOB 9. Annual reporting and evaluation

OBJECTIVE: Summarize and report study results, evaluate study plan implementation, and revise the study plan as needed.

PURPOSE: To keep information development up-to-date, and to provide the opportunity to make midterm evaluations and adjustments to the study plan, as necessary.

PROCEDURES: The TAC biologist will prepare a draft report that will summarize the results of the year's work through June 30 of each year. The draft report will undergo TAC review and comments will be incorporated to produce a final annual report. This review process will provide the TAC an opportunity to evaluate the efficacy of study elements in achieving their desired objectives, and to amend the study plan as needed in an attempt to improve or modify future studies.

SCHEDULE: The draft annual report will be due by 1 September of each study year, and review completed by 1 October. The final annual report and proposed changes to the study plan will be due by 1 November to the Consensus Committee.

JOB 10. Management action analysis

OBJECTIVE: Analyze the various, potential management actions relative to meeting the goals and objectives defined in this proposal and develop a technically-based management recommendation in the context of the evaluation criteria discussed above for consideration by the TAC.

PURPOSE: To summarize through analysis the results of the proposed study in the form of a range of potential management actions for fish populations within the lower Santa Ynez River system.

PROCEDURES: Analytical tools developed to evaluate habitat quantity and quality versus flow, and non-flow habitat, and temperature modifications will be used to identify various alternative management actions and predicted influences (both negative and positive) on fish habitat needs and other uses of the lower Santa Ynez River system. Various scenarios will be contemplated for optimizing fish habitat, including steelhead/trout restoration in the lower river and its tributaries, implementation of non-flow habitat improvements, tributary flow and non-flow habitat based improvements, minimal changes intended only to accommodate existing fish populations in the lower river and the maintenance of a steelhead/trout population in tributaries and the system upstream of Bradbury Dam, and no-action.

SCHEDULE: A final synthesis report detailing the approach and information used to identify a recommended management action will be completed through iterative review by the biological subcommittee and the TAC by November 1, 1998.

SUMMARY SCHEDULE FOR LONG-TERM STUDY PLAN

Job	Activity	Schedule	Investigator
Job 1: Habitat inventory	Habitat typing main stem	Mar-Apr 1996	DFG, TAC and FWS scientists
	Ground truthing main stem	Mar-Apr 1996	DFG, TAC and FWS scientists
Job 2: Habitat function	Redd survey	Feb 1996-May 1996, Dec 1996-May 1997, Dec 1997-May 1998	TAC and FWS biologists
	Juvenile rearing survey	Monthly, Mar 96-Jun 99	TAC and FWS biologists
	Main stem trapping	Nearly year-round, Jan 1996-Jun 1999	TAC and FWS biologists
	Tributary trapping	Jan 1996-summer 1996, Jan 1997-summer 1997, Jan 1998-summer 1998, Jan 1999-summer 1999	TAC and FWS biologists
Job 3: Habitat-flow relationships	Data collection for PHABSIM	Opportunistically with suitable flows	TAC and FWS biologists
	PHABSIM modeling	TBA following data collection	DFG, TAC and FWS biologists
Job 4: Temperature and DO work	Evaluation of data collected to date, model selection	ASAP following adoption of long term study plan	TAC and FWS biologists, Biology Subcommittee
	Further data collection	Continuously thru summer 1999	TAC and FWS biologists, Hanson Environmental
	Temp modeling	TBA	TBA
Job 5: Trib-mainstem relationships	Adult trapping, redd monitoring, juvenile surveys, emigrant trapping	See Job 2	See Job 2
Job 6: Flow verification	Water releases, Job 2 activities	Opportunistically, following development of recommended flows	TAC
Job 7: Genetic analysis of steelhead/rainbow trout	Collect tissue samples Determine proper methods	Opportunistically archive samples. No date for analyses	TAC
Job 8: Coordination and collaboration	Coordinating with other study activities in SYR	Ongoing, as information becomes available	TAC, TAC and FWS biologists
Job 9: Annual reporting	Reporting and evaluating each year's work	Annual reports and study plan changes due by 1 Nov 96-98	TAC and FWS biologists, TAC Biology Subcomm.
Job 10: Management action analysis	Final data synthesis, reporting, and analysis of management actions	Management alternatives due 1 Nov 98.	TAC

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APPENDIX 1.

Habitat Inventory Data Sheet and Measurements

HABITAT INVENTORY DATA SHEET

Stream		Date:	page #___ of___

Data Recorder:	Data Collectors:

Reach #	Air T°	Water T°	Discharge:	Average Velocity:

HABITAT MEASUREMENTS

Habitat Unit #										
Habitat Unit Type										
Total Length										
Average Width										
Average Depth										
Maximum Depth										

PERCENT UNIT SHELTER (quartiles)

% Unit Covered										
% undercut banks										
% swd (d<12")										
% lwd (d>12")										
% root mass										
% terrestrial veg.										
% aquatic veg.										
% white water										
% boulders										
% bedrock ledges										
Percent Canopy										

BANK COMPOSITION

right bank dominant type										
% right bank vegetated										
left bank dominant type										
% left bank vegetated										

Bank composition types: 1. bedrock/rock 2. boulder 3. cobble/gravel 4. bare soil 5. grass 6. brush 7. trees

SUBSTRATE COMPOSITION

and / silt / clay (circle one)										
ravel (0.08" - 2")										
nall cobble (2"- 5")										
rge cobble (5" - 10")										
ulder (>10")										

Habitat Inventory Measurements

1. **Reach:** use reach designations chosen for the stream flow evaluation.

2. **Average velocity:** measure at least 5 random point velocities within the habitat unit and calculate average.

3. **Habitat unit number:** numbers should be in sequential order beginning with 1 at the downstream most end of a reach.

4. **Habitat unit type:** riffle, pool, run.

   riffle: area of topographic high caused by deposition or concentration of cobble and gravel, water is shallower, faster moving and more turbulent than either a pool or run.

   pool: typically an area of scour characterized by deeper, slower moving water with bed materials typically finer than found in either riffles or runs.

   run: an area of neither active deposition or scour but transitional between riffles and pools, characterized by water moving faster than in pools but flow less turbulent than in riffles.

5. **Total length:** measure total length of habitat unit along the thalweg of the channel (deepest longitudinal segment of channel).

6. **Average width:** measure at least three channel widths within the habitat unit and calculate average.

7. **Average depth:** take at least three random depth measurements across the unit with a stadia rod and calculate average.

8. **Maximum depth:** enter the measured maximum depth for each habitat unit.

9. **Percent unit shelter:** enter the percentage (in quartiles) of the total unit occupied by structural shelter. Classify 100% of the cover (in quartiles) by the types of shelter indicated on the data sheet.

10. **Percent total canopy:** enter the estimated percentage of the water surface covered by the tree canopy in the overhead view of the unit.

11. **Bank composition:** enter the number for the bank dominant composition type from the list at the bottom of this section.

12. **Substrate composition:** enter a "1" for the dominant substrate and a "2" for the secondary substrate.

Appendix B

Santa Ynez River Hydrology and Cachuma Project Daily Operations 1991-1996

Cachuma Lake Elevation

CACHUMA RESERVOIR
LAKE ELEVATION (Feet)
Water Year 1991

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	668.08	666.42	664.80	663.10	662.05	661.62	693.82	699.59	699.34	695.81	693.63	692.01
2	668.04	666.34	664.75	663.07	662.02	662.11	694.38	699.59	699.33	695.72	693.58	691.94
3	667.98	666.30	664.70	663.05	661.98	662.20	694.86	699.62	699.32	695.63	693.50	691.85
4	667.94	666.25	664.64	663.06	661.81	662.21	695.34	699.63	699.30	695.52	693.43	691.84
5	667.90	666.20	664.58	663.05	661.92	662.53	695.79	699.67	699.28	695.42	693.36	691.77
6	667.87	666.16	664.51	663.01	661.90	662.62	696.21	699.70	699.25	695.30	693.30	691.70
7	667.83	666.10	664.46	663.00	661.86	662.65	696.56	699.72	699.11	695.21	693.24	691.63
8	667.78	666.03	664.40	662.98	661.81	662.66	696.89	699.73	698.96	695.10	693.19	691.55
9	667.75	665.98	664.34	662.98	661.76	662.66	697.20	699.68	698.79	694.97	693.14	691.48
10	667.70	665.95	664.27	662.93	661.72	662.66	697.39	699.68	698.63	694.93	693.10	691.41
11	667.67	665.87	664.21	662.90	661.69	662.67	697.62	699.68	698.45	694.89	693.06	691.32
12	667.61	665.80	664.17	662.85	661.66	662.67	697.79	699.69	698.29	694.84	693.02	691.27
13	667.55	665.74	664.13	662.82	661.61	662.68	697.92	699.69	698.13	694.79	693.01	691.21
14	667.49	665.68	664.03	662.81	661.60	662.67	698.09	699.68	697.96	694.74	692.97	691.16
15	667.45	665.61	663.94	662.75	661.55	662.66	698.22	699.67	697.78	694.70	692.92	691.10
16	667.39	665.55	663.83	662.70	661.52	662.68	698.41	699.68	697.62	694.65	692.88	691.04
17	667.34	665.49	663.75	662.66	661.44	662.69	698.53	699.66	697.45	694.59	692.83	691.01
18	667.30	665.41	663.72	662.61	661.40	663.33	698.64	699.60	697.32	694.54	692.76	690.96
19	667.25	665.33	663.70	662.56	661.35	672.58	698.74	699.59	697.17	694.48	692.72	690.91
20	667.16	665.29	663.65	662.53	661.33	677.60	698.75	699.58	697.01	694.42	692.67	690.86
21	667.07	665.23	663.60	662.50	661.29	680.63	698.86	699.59	696.87	694.36	692.61	690.82
22	667.00	665.19	663.55	662.46	661.26	682.00	698.99	699.58	696.73	694.30	692.55	690.77
23	666.93	665.16	663.50	662.41	661.21	682.71	699.08	699.57	696.59	694.25	692.50	690.73
24	666.89	665.12	663.46	662.37	661.15	683.31	699.16	699.57	696.46	694.18	692.46	690.68
25	666.84	665.06	663.43	662.33	661.09	684.14	699.23	699.56	696.31	694.12	692.41	690.64
26	666.78	665.03	663.40	662.30	661.07	685.02	699.29	699.53	696.22	694.04	692.38	690.59
27	666.73	664.98	663.37	662.25	661.06	688.08	699.38	699.49	696.13	693.97	692.30	690.48
28	666.67	664.93	663.31	662.23	661.31	689.86	699.44	699.47	696.04	693.90	692.20	690.40
29	666.63	664.90	663.23	662.17		691.06	699.51	699.44	695.95	693.84	692.16	690.34
30	666.56	664.85	663.15	662.15		692.18	699.56	699.41	695.87	693.78	692.10	690.29
31	666.50		663.12	662.11		693.04		699.37		693.71	692.05	
Min	**666.50**	**664.85**	**663.12**	**662.11**	**661.06**	**661.62**	**693.82**	**699.37**	**695.87**	**693.71**	**692.05**	**690.29**
Max	**668.08**	**666.42**	**664.80**	**663.10**	**662.05**	**693.04**	**699.56**	**699.73**	**699.34**	**695.81**	**693.63**	**692.01**
Avg	**667.34**	**665.60**	**663.93**	**662.67**	**661.55**	**671.88**	**697.79**	**699.60**	**697.72**	**694.67**	**692.84**	**691.13**

CACHUMA RESERVOIR
LAKE ELEVATION (Feet)
Water Year 1992

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	690.23	684.33	683.23	683.17	684.28	731.37	742.28	745.76	746.01	745.19	743.41	740.52
2	690.02	684.29	683.21	683.16	684.27	731.59	742.55	745.78	746.00	745.15	743.35	740.43
3	689.79	684.26	683.17	683.19	684.26	732.02	742.81	745.80	745.99	745.03	743.30	740.33
4	689.56	684.23	683.16	683.20	684.26	732.32	743.04	745.82	745.97	744.91	743.23	740.21
5	689.32	684.20	683.15	683.38	684.25	732.58	743.25	745.83	745.96	744.82	743.18	740.12
6	689.09	684.18	683.12	683.99	684.29	733.12	743.45	745.85	745.95	744.75	743.12	740.02
7	688.87	684.15	683.10	684.16	684.31	733.81	743.63	745.87	745.93	744.65	743.06	739.91
8	688.61	684.11	683.08	684.24	684.30	734.19	743.82	745.91	745.91	744.55	743.03	739.80
9	688.37	684.08	683.05	684.29	684.30	734.48	743.98	745.92	745.89	744.51	742.97	739.70
10	688.11	684.03	683.03	684.32	684.80	734.75	744.14	745.96	745.88	744.47	742.93	739.59
11	687.86	684.00	683.02	684.34	688.87	735.01	744.28	745.99	745.86	744.42	742.88	739.48
12	687.61	683.96	682.99	684.34	695.47	735.22	744.43	746.02	745.84	744.39	742.80	739.40
13	687.36	683.92	682.96	684.34	710.16	735.46	744.55	746.05	745.81	744.35	742.78	739.32
14	687.11	683.84	682.92	684.34	715.21	735.66	744.66	746.06	745.77	744.32	742.73	739.24
15	686.88	683.78	682.90	684.36	718.04	735.83	744.79	746.07	745.74	744.30	742.68	739.19
16	686.64	683.73	682.88	684.36	722.87	735.99	744.90	746.08	745.71	744.26	742.63	739.14
17	686.41	683.71	682.87	684.36	724.79	736.14	745.02	746.09	745.69	744.23	742.57	739.10
18	686.17	683.67	682.84	684.36	726.09	736.30	745.10	746.11	745.66	744.19	742.54	739.05
19	685.92	683.65	682.79	684.34	727.05	736.46	745.20	746.11	745.64	744.14	742.49	739.02
20	685.72	683.62	682.73	684.35	727.84	736.62	745.27	746.10	745.61	744.11	742.42	738.97
21	685.55	683.60	682.70	684.34	728.35	736.88	745.34	746.09	745.58	744.05	742.24	738.93
22	685.34	683.57	682.69	684.33	728.90	737.15	745.41	746.09	745.55	744.01	742.10	738.91
23	685.14	683.55	682.67	684.33	729.33	737.95	745.48	746.08	745.53	743.95	741.94	738.77
24	685.00	683.51	682.64	684.33	729.75	738.88	745.55	746.08	745.49	743.90	741.78	738.68
25	684.90	683.48	682.61	684.33	730.07	739.49	745.61	746.07	745.45	743.83	741.63	738.60
26	684.81	683.47	682.58	684.32	730.38	739.95	745.66	746.06	745.41	743.76	741.47	738.54
27	684.69	683.43	682.56	684.32	730.67	740.41	745.68	746.05	745.38	743.70	741.31	738.47
28	684.60	683.38	682.73	684.32	730.91	740.91	745.72	746.04	745.33	743.64	741.15	738.39
29	684.50	683.33	682.92	684.31	731.15	741.29	745.74	746.04	745.29	743.58	740.99	738.31
30	684.39	683.28	683.10	684.31		741.61	745.75	746.03	745.24	743.53	740.84	738.25
31	684.36		683.17	684.30		741.97		746.02		743.47	740.69	
Min	**684.36**	**683.28**	**682.56**	**683.16**	**684.25**	**731.37**	**742.28**	**745.76**	**745.24**	**743.47**	**740.69**	**738.25**
Max	**690.23**	**684.33**	**683.23**	**684.36**	**731.15**	**741.97**	**745.75**	**746.11**	**746.01**	**745.19**	**743.41**	**740.52**
Avg	**686.87**	**683.81**	**682.92**	**684.13**	**709.28**	**736.30**	**744.57**	**745.99**	**745.70**	**744.26**	**742.39**	**739.28**

CACHUMA RESERVOIR
LAKE ELEVATION (Feet)
Water Year 1992

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	738.15	736.63	735.68	735.81	750.20	750.34	750.23	750.23	750.22	749.75	748.58	746.96
2	738.05	736.59	735.64	735.87	750.20	750.32	750.26	750.26	750.21	749.71	748.54	746.93
3	737.96	736.55	735.62	735.89	750.21	750.34	750.28	750.25	750.20	749.67	748.48	746.90
4	737.89	736.53	735.60	735.91	750.18	750.32	750.27	750.25	750.20	749.62	748.46	746.85
5	737.82	736.50	735.59	735.93	750.18	750.31	750.26	750.26	750.23	749.57	748.38	746.80
6	737.73	736.46	735.58	735.93	750.16	750.33	750.23	750.25	750.24	749.54	748.32	746.75
7	737.64	736.43	735.70	736.36	750.14	750.25	750.26	750.22	750.24	749.51	748.25	746.68
8	737.58	736.41	735.71	737.62	750.71	750.28	750.23	750.20	750.25	749.48	748.17	746.64
9	737.51	736.38	735.70	738.44	750.27	750.27	750.23	750.22	750.27	749.45	748.12	746.60
10	737.45	736.36	735.69	738.75	750.22	750.20	750.22	750.25	750.29	749.41	748.06	746.55
11	737.40	736.33	735.69	738.95	750.21	750.21	750.23	750.24	750.28	749.38	748.01	746.49
12	737.34	736.30	735.67	739.15	750.25	750.23	750.24	750.24	750.26	749.35	747.96	746.45
13	737.30	736.27	735.65	739.95	750.21	750.19	750.24	750.24	750.24	749.31	747.90	746.42
14	737.23	736.24	735.64	745.92	750.19	750.21	750.25	750.24	750.22	749.28	747.85	746.34
15	737.18	736.21	735.63	748.63	750.24	750.26	750.24	750.23	750.20	749.26	747.80	746.29
16	737.13	736.19	735.62	750.43	750.27	750.29	750.24	750.22	750.18	749.21	747.74	746.25
17	737.07	736.15	735.60	750.08	750.21	750.30	750.29	750.21	750.16	749.18	747.70	746.21
18	737.01	736.12	735.60	750.58	750.29	750.28	750.32	750.19	750.14	749.14	747.64	746.19
19	736.96	736.00	735.59	750.28	750.88	750.26	750.30	750.19	750.12	749.10	747.60	746.14
20	736.94	735.98	735.57	750.23	750.49	750.23	750.28	750.19	750.10	749.06	747.54	746.09
21	736.91	735.99	735.56	750.22	750.44	750.20	750.27	750.19	750.08	749.02	747.49	746.04
22	736.88	735.97	735.54	750.26	750.36	750.19	750.25	750.20	750.06	748.97	747.45	746.00
23	736.86	735.95	735.53	750.20	750.73	750.25	750.27	750.22	750.03	748.93	747.40	745.96
24	736.83	735.91	735.52	750.19	750.46	750.29	750.27	750.25	750.01	748.90	747.36	745.91
25	736.79	735.88	735.51	750.20	750.35	750.47	750.28	750.26	749.99	748.86	747.32	745.86
26	736.76	735.84	735.50	750.28	750.36	750.90	750.28	750.26	749.96	748.82	747.26	745.82
27	736.71	735.81	735.48	750.19	750.35	750.33	750.26	750.25	749.93	748.76	747.21	745.79
28	736.68	735.78	735.47	750.20	750.37	750.28	750.23	750.23	749.90	748.72	747.16	745.73
29	736.65	735.75	735.64	750.25		750.28	750.23	750.22	749.86	748.69	747.10	745.69
30	736.64	735.71	735.76	750.24		750.24	750.21	750.22	749.80	748.66	747.05	745.64
31	736.65		735.80	750.19		750.30		750.23		748.61	747.02	
Min	**736.64**	**735.71**	**735.47**	**735.81**	**750.14**	**750.19**	**750.21**	**750.19**	**749.80**	**748.61**	**747.02**	**745.64**
Max	**738.15**	**736.63**	**735.80**	**750.58**	**750.88**	**750.90**	**750.32**	**750.26**	**750.29**	**749.75**	**748.58**	**746.96**
Avg	**737.22**	**736.17**	**735.62**	**744.62**	**750.33**	**750.30**	**750.26**	**750.23**	**750.13**	**749.19**	**747.77**	**746.30**

CACHUMA RESERVOIR
LAKE ELEVATION (Feet)
Water Year 1994

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	745.59	744.50	743.86	743.86	743.62	746.36	747.13	746.82	746.19	744.74	742.20	738.45
2	745.55	744.46	743.84	743.85	743.62	746.40	747.13	746.81	746.15	744.67	742.04	738.33
3	745.52	744.44	743.83	743.85	743.62	746.43	747.14	746.80	746.10	744.60	741.88	738.23
4	745.49	744.40	743.82	743.84	743.67	746.45	747.14	746.79	746.05	744.54	741.73	738.15
5	745.45	744.37	743.81	743.82	743.67	746.46	747.14	746.77	746.00	744.49	741.57	738.05
6	745.41	744.35	743.79	743.80	743.68	746.51	747.13	746.75	745.95	744.44	741.40	737.96
7	745.38	744.32	743.78	743.79	743.76	746.59	747.13	746.72	745.91	744.38	741.26	737.86
8	745.35	744.30	743.77	743.78	744.04	746.60	747.13	746.72	745.86	744.34	741.15	737.76
9	745.31	744.27	743.75	743.76	744.12	746.62	747.12	746.70	745.82	744.28	741.02	737.66
10	745.29	744.25	743.74	743.75	744.12	746.64	747.11	746.68	745.78	744.22	740.94	737.56
11	745.28	744.24	743.75	743.74	744.14	746.64	747.11	746.67	745.73	744.16	740.84	737.45
12	745.26	744.22	743.87	743.72	744.15	746.66	747.10	746.65	745.70	744.09	740.75	737.34
13	745.23	744.20	743.89	743.70	744.15	746.67	747.08	746.63	745.66	744.03	740.64	737.24
14	745.20	744.17	743.90	743.68	744.15	746.68	747.07	746.61	745.62	743.96	740.55	737.14
15	745.17	744.15	743.93	743.65	744.16	746.69	747.06	746.59	745.58	743.91	740.44	737.05
16	745.14	744.12	743.93	743.62	744.16	746.68	747.04	746.56	745.55	743.87	740.33	736.97
17	745.11	744.10	743.93	743.59	744.33	746.67	747.02	746.53	745.50	743.80	740.21	736.87
18	745.08	744.08	743.93	743.57	744.42	746.67	747.01	746.54	745.46	743.74	740.09	736.79
19	745.05	744.06	743.92	743.56	744.47	746.68	746.99	746.53	745.42	743.68	739.98	736.71
20	745.02	744.04	743.92	743.53	745.02	746.71	746.97	746.51	745.38	743.62	739.85	736.63
21	744.99	744.02	743.92	743.52	745.69	746.72	746.94	746.48	745.33	743.55	739.73	736.55
22	744.86	744.00	743.91	743.51	745.94	746.71	746.91	746.46	745.26	743.49	739.62	736.47
23	744.92	743.99	743.90	743.54	746.08	746.71	746.88	746.44	745.21	743.43	739.51	736.40
24	744.87	743.96	743.90	743.55	746.15	746.73	746.86	746.42	745.14	743.37	739.38	736.34
25	744.82	743.95	743.89	743.62	746.19	746.91	746.85	746.40	745.09	743.31	739.27	736.27
26	744.78	743.93	743.89	743.64	746.24	746.99	746.86	746.37	745.04	743.17	739.14	736.20
27	744.73	743.90	743.89	743.65	746.28	747.02	746.85	746.33	744.99	743.00	739.01	736.14
28	744.69	743.89	743.89	743.65	746.32	747.05	746.85	746.30	744.93	742.84	738.91	736.07
29	744.58	743.85	743.89	743.65		747.08	746.84	746.28	744.87	742.69	738.78	736.01
30	744.58	743.87	743.88	743.63		747.09	746.83	746.25	744.81	742.52	738.67	735.94
31	744.53		743.87	743.63		747.11		746.22		742.36	738.56	
Min	**744.53**	**743.85**	**743.74**	**743.51**	**743.62**	**746.36**	**746.83**	**746.22**	**744.81**	**742.36**	**738.56**	**735.94**
Max	**745.59**	**744.50**	**743.93**	**743.86**	**746.32**	**747.11**	**747.14**	**746.82**	**746.19**	**744.74**	**742.20**	**738.45**
Avg	**745.10**	**744.15**	**743.86**	**743.68**	**744.64**	**746.71**	**747.01**	**746.56**	**745.54**	**743.78**	**740.30**	**737.09**

CACHUMA RESERVOIR
LAKE ELEVATION (Feet)
Water Year 1995

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	735.87	734.01	733.11	732.56	739.46	733.21	733.05	733.08	733.49	733.34	732.21	730.75
2	735.80	733.95	733.08	732.55	738.88	733.25	733.07	733.07	733.53	733.29	732.16	730.69
3	735.73	733.90	733.06	732.62	738.27	733.23	733.05	733.07	733.57	733.23	732.12	730.63
4	735.70	733.87	733.03	732.73	737.84	733.20	733.03	733.07	733.61	733.17	732.08	730.58
5	735.68	733.82	733.01	733.13	737.38	733.28	733.08	733.07	733.64	733.13	732.03	730.51
6	735.64	733.79	732.99	733.20	736.94	735.01	733.08	733.07	733.67	733.08	731.98	730.47
7	735.60	733.76	732.98	733.30	736.50	734.74	733.07	733.07	733.67	733.05	731.94	730.42
8	735.56	733.74	732.95	733.38	736.05	733.65	733.06	733.08	733.69	733.05	731.89	730.36
9	735.51	733.70	732.93	733.84	735.56	733.00	733.04	733.09	733.71	733.02	731.85	730.30
10	735.45	733.72	732.91	738.44	735.02	733.07	733.12	733.11	733.73	733.00	731.80	730.26
11	735.37	733.69	732.88	749.14	734.46	741.40	733.10	733.13	733.76	732.98	731.75	730.20
12	735.28	733.66	732.87	749.57	734.06	744.52	733.08	733.10	733.78	732.95	731.70	730.15
13	735.18	733.62	732.86	748.76	733.54	744.05	733.06	733.11	733.78	732.91	731.65	730.10
14	735.08	733.61	732.84	747.71	733.72	742.75	733.27	733.15	733.79	732.88	731.60	730.06
15	734.98	733.58	732.83	746.93	734.58	740.80	733.30	733.23	733.78	732.85	731.55	730.01
16	734.87	733.55	732.81	746.04	734.46	738.84	733.24	733.40	733.77	732.81	731.50	729.97
17	734.79	733.51	732.79	745.14	734.14	736.76	733.16	733.45	733.77	732.77	731.46	729.93
18	734.72	733.49	732.76	744.20	733.74	735.10	733.14	733.47	733.77	732.72	731.41	729.89
19	734.65	733.45	732.75	743.30	733.35	734.04	733.08	733.51	733.75	732.69	731.37	729.84
20	734.58	733.42	732.74	742.54	733.04	733.34	733.07	733.53	733.74	732.66	731.34	729.80
21	734.55	733.40	732.72	742.09	732.96	733.16	733.08	733.54	733.71	732.62	731.29	729.76
22	734.50	733.39	732.69	741.27	732.94	733.08	733.10	733.53	733.69	732.59	731.24	729.72
23	734.45	733.36	732.67	740.55	732.99	734.20	733.09	733.54	733.67	732.56	731.19	729.68
24	734.40	733.31	732.65	741.81	733.06	733.81	733.09	733.57	733.64	732.53	731.15	729.65
25	734.35	733.28	732.66	749.57	733.12	733.09	733.04	733.60	733.61	732.49	731.10	729.59
26	734.30	733.25	732.64	750.36	733.18	733.04	733.04	733.60	733.57	732.46	731.05	729.55
27	734.25	733.21	732.62	748.18	733.22	733.10	733.07	733.58	733.53	732.42	731.00	729.51
28	734.21	733.18	732.60	746.35	733.23	733.08	733.07	733.54	733.49	732.40	730.96	729.47
29	734.16	733.16	732.60	744.45		733.05	733.10	733.50	733.44	732.34	730.91	729.43
30	734.10	733.14	732.58	742.43		733.10	733.10	733.46	733.39	732.30	730.86	729.39
31	734.06		732.58	740.41		733.09		733.47		732.25	730.81	
Min	**734.06**	**733.14**	**732.58**	**732.55**	**732.94**	**733.00**	**733.03**	**733.07**	**733.39**	**732.25**	**730.81**	**729.39**
Max	**735.87**	**734.01**	**733.11**	**750.36**	**739.46**	**744.52**	**733.30**	**733.60**	**733.79**	**733.34**	**732.21**	**730.75**
Avg	**734.95**	**733.55**	**732.81**	**741.50**	**734.85**	**735.26**	**733.10**	**733.32**	**733.66**	**732.79**	**731.51**	**730.02**

CACHUMA RESERVOIR
LAKE ELEVATION (Feet)
Water Year 1996

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	729.33	728.07	727.24	726.71	726.44	733.11	735.92	736.10	735.02	733.46	729.90	726.11
2	729.28	728.05	727.21	726.68	726.49	733.22	735.99	736.06	734.99	733.39	729.77	726.01
3	729.25	728.03	727.17	726.67	726.60	733.29	736.02	736.03	734.96	733.32	729.63	725.91
4	729.18	728.00	727.14	726.64	726.67	733.40	736.06	735.99	734.92	733.25	729.50	725.81
5	729.14	727.98	727.10	726.61	726.70	733.51	736.10	735.94	734.86	733.19	729.36	725.70
6	729.08	727.95	727.07	726.57	726.80	733.60	736.13	735.90	734.81	733.11	729.23	725.60
7	729.02	727.92	727.05	726.57	726.85	733.69	736.13	735.85	734.76	733.06	729.10	725.50
8	728.97	727.90	727.03	726.55	726.86	733.76	736.16	735.80	734.72	732.95	728.96	725.40
9	728.93	727.86	727.00	726.51	726.88	733.83	736.17	735.75	734.68	732.88	728.84	725.30
10	728.87	727.83	726.97	726.49	726.88	733.88	736.17	735.72	734.61	732.81	728.71	725.15
11	728.83	727.80	726.94	726.45	726.89	733.93	736.17	735.68	734.56	732.75	728.61	725.05
12	728.79	727.78	726.96	726.43	726.89	734.00	736.18	735.66	734.50	732.68	728.49	724.94
13	728.76	727.73	726.96	726.39	726.90	734.26	736.18	735.63	734.44	732.62	728.36	724.82
14	728.72	727.70	726.93	726.36	726.90	734.56	736.19	735.60	734.39	732.56	728.24	724.71
15	728.68	727.68	726.93	726.34	726.90	734.73	736.19	735.56	734.34	732.49	728.12	724.62
16	728.64	727.64	726.89	726.31	726.92	734.88	736.20	735.55	734.29	732.42	728.00	724.51
17	728.60	727.61	726.88	726.32	726.90	735.01	736.20	735.53	734.24	732.35	727.88	724.40
18	728.57	727.59	726.86	726.29	726.90	735.11	736.20	735.50	734.20	732.28	727.76	724.30
19	728.54	727.56	726.84	726.28	726.90	735.20	736.23	735.46	734.13	732.12	727.63	724.20
20	728.51	727.54	726.83	726.27	728.04	735.29	736.22	735.43	734.07	731.93	727.52	724.08
21	728.49	727.51	726.81	726.24	730.26	735.37	736.22	735.41	734.02	731.76	727.39	723.98
22	728.44	727.49	726.84	726.23	731.33	735.44	736.23	735.36	733.95	731.57	727.26	723.87
23	728.40	727.47	726.83	726.21	731.88	735.48	736.23	735.33	733.89	731.39	727.15	723.78
24	728.36	727.45	726.83	726.17	732.19	735.56	736.23	735.30	733.84	731.20	727.03	723.69
25	728.31	727.43	726.82	726.19	732.39	735.61	736.22	735.26	733.78	731.02	726.88	723.58
26	728.27	727.40	726.81	726.18	732.58	735.66	736.22	735.24	733.72	730.84	726.74	723.49
27	728.23	727.38	726.78	726.17	732.71	735.70	736.20	735.21	733.67	730.67	726.60	723.39
28	728.20	727.34	726.80	726.18	732.90	735.76	736.18	735.18	733.61	730.48	726.49	723.30
29	728.16	727.32	726.76	726.17	733.05	735.80	736.16	735.14	733.55	730.30	726.40	723.21
30	728.12	727.29	726.71	726.17		735.84	736.13	735.09	733.51	730.17	726.31	723.13
31	728.09		726.71	726.22		735.88		735.05		730.04	726.21	
Min	**728.09**	**727.29**	**726.71**	**726.17**	**726.44**	**733.11**	**735.92**	**735.05**	**733.51**	**730.04**	**726.21**	**723.13**
Max	**729.33**	**728.07**	**727.24**	**726.71**	**733.05**	**735.88**	**736.23**	**736.10**	**735.02**	**733.46**	**729.90**	**726.11**
Avg	**728.67**	**727.68**	**726.93**	**726.37**	**728.50**	**734.66**	**736.16**	**735.56**	**734.30**	**732.10**	**728.00**	**724.58**

Cachuma Storage

CACHUMA RESERVOIR
STORAGE (Acre-feet)
Water Year 1991

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	34137.8	32530.2	31016.2	29475.9	28545.2	28169.6	66209.8	75301.3	74892.3	69264.0	65923.4	63501.9
2	34097.9	32454.0	30970.5	29448.9	28518.7	28598.3	67061.7	75301.3	74875.9	69124.2	65848.1	63399.0
3	34038.5	32415.9	30924.8	29430.9	28483.5	28678.0	67795.1	75350.3	74859.5	68984.9	65727.5	63267.1
4	33999.5	32368.3	30870.0	29439.9	28335.3	28686.9	68535.7	75366.7	74826.8	68814.5	65622.0	63252.5
5	33960.5	32320.6	30815.1	29430.9	28431.2	28970.1	69232.7	75432.1	74794.1	68659.6	65516.5	63149.9
6	33931.3	32282.5	30751.2	29395.0	28413.8	29049.7	69887.7	75481.2	74745.0	68473.7	65426.1	63047.2
7	33892.3	32225.3	30705.5	29386.0	28378.9	29076.3	70437.2	75513.9	74515.9	68334.3	65335.7	62944.6
8	33843.5	32158.6	30650.6	29368.3	28335.3	29085.1	70955.3	75530.3	74271.4	68163.9	65260.3	62827.3
9	33814.3	32111.4	30595.8	29368.3	28291.7	29085.1	71446.6	75448.5	73996.8	67963.1	65185.0	62724.7
10	33765.5	32083.5	30531.8	29324.0	28256.8	29085.1	71749.3	75448.5	73738.5	67902.0	65124.7	62622.0
11	33736.2	32009.0	30477.0	29297.5	28230.7	29093.9	72115.7	75448.5	73447.8	67841.0	65064.4	62490.1
12	33677.7	31943.8	30440.4	29253.2	28204.5	29093.9	72386.4	75464.8	73189.3	67764.6	65004.2	62416.9
13	33619.2	31887.9	30403.8	29226.7	28160.9	29102.8	72593.5	75464.8	72931.0	67688.1	64989.1	62328.9
14	33560.7	31832.1	30312.5	29217.9	28152.2	29093.9	72866.4	75448.5	72657.3	67611.7	64929.4	62255.5
15	33521.8	31766.9	30231.1	29164.8	28108.6	29085.1	73076.3	75432.1	72370.6	67550.6	64855.0	62167.6
16	33463.3	31711.0	30132.2	29120.5	28082.5	29102.8	73383.1	75448.5	72115.7	67474.2	64795.6	62079.6
17	33414.5	31655.2	30060.3	29085.1	28012.7	29111.7	73577.0	75415.7	71844.9	67382.6	64721.2	62035.7
18	33375.5	31580.7	30033.3	29040.8	27977.8	29682.7	73754.6	75317.6	71637.8	67306.1	64617.1	61963.2
19	33326.8	31506.3	30015.3	28996.6	27934.2	38800.4	73916.1	75301.3	71398.8	67214.4	64557.6	61890.9
20	33239.0	31469.0	29970.4	28970.1	27916.8	44474.0	73932.3	75284.9	71144.0	67122.7	64483.3	61818.7
21	33151.3	31413.1	29925.4	28943.5	27881.9	48120.3	74109.9	75301.3	70923.9	67031.1	64394.1	61760.9
22	33083.0	31375.9	29880.4	28908.1	27855.7	49824.0	74319.8	75284.9	70704.1	66939.4	64304.8	61688.7
23	33016.3	31347.9	29835.5	28863.8	27812.1	50725.0	74466.9	75268.5	70484.3	66863.0	64230.5	61630.8
24	32978.2	31310.7	29799.6	28828.5	27759.8	51492.6	74597.7	75268.5	70280.2	66756.0	64171.1	61558.6
25	32930.6	31254.9	29772.6	28793.1	27707.5	52565.3	74712.3	75252.2	70044.7	66664.4	64096.6	61500.8
26	32873.4	31227.0	29745.6	28766.5	27690.1	53717.6	74810.4	75203.1	69903.4	66542.1	64052.1	61428.6
27	32825.7	31180.7	29718.6	28722.3	27681.3	56024.1	74957.7	75137.6	69762.1	66435.7	63933.1	61269.6
28	32768.5	31135.0	29664.7	28704.5	27899.3	60376.8	75055.8	75104.9	69620.8	66330.3	63784.4	61154.0
29	32730.4	31107.6	29592.8	28651.4		62109.0	75170.4	75055.8	69480.6	66239.9	63724.9	61067.3
30	32663.7	31061.9	29520.9	28633.8		63754.7	75252.2	75006.7	69357.0	66149.5	63635.7	60995.0
31	32606.5		29493.9	28598.3		65034.3		74941.3		66044.0	63561.3	
Min	**32606.5**	**31061.9**	**29493.9**	**28598.3**	**27681.3**	**28169.6**	**66209.8**	**74941.3**	**69357.0**	**66044.0**	**63561.3**	**60995.0**
Max	**34137.8**	**32530.2**	**31016.2**	**29475.9**	**28545.2**	**65034.3**	**75252.2**	**75530.3**	**74892.3**	**69264.0**	**65923.4**	**63501.9**
Avg	**33420.7**	**31757.6**	**30221.2**	**29092.1**	**28109.3**	**39318.4**	**72412.2**	**75323.4**	**72293.8**	**67504.4**	**64737.9**	**62207.9**

CACHUMA RESERVOIR
STORAGE (Acre-feet)
Water Year 1992

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	60908.3	52814.0	51389.5	51312.1	52748.6	139614.7	167965.5	177825.6	178547.2	176181.2	171121.5	163139.8
2	60604.9	52761.6	51363.7	51299.2	52735.5	140150.9	168716.0	177883.4	178518.0	176065.8	170952.5	162895.7
3	60277.1	52722.4	51312.1	51337.9	52722.4	141199.4	169438.8	177941.0	178489.1	175719.6	170811.8	162624.7
4	59949.9	52683.0	51299.2	51350.8	52722.4	141939.5	170079.6	177998.7	178431.4	175376.4	170614.6	162299.4
5	59608.4	52643.8	51286.4	51582.8	52709.3	142580.9	170671.0	178027.6	178402.7	175120.0	170473.9	162055.3
6	59281.1	52617.6	51247.7	52369.1	52761.6	143916.6	171234.2	178085.2	178373.8	174920.5	170304.9	161784.3
7	58970.9	52578.4	51221.9	52591.4	52787.8	145639.6	171741.1	178142.9	178316.0	174635.6	170136.0	161488.9
8	58606.6	52526.0	51196.1	52696.2	52774.7	146594.1	172276.1	178258.3	178258.3	174350.5	170051.6	161194.4
9	58270.4	52486.7	51157.4	52761.6	52774.7	147326.9	172726.6	178287.2	178200.7	174236.5	169883.5	160926.6
10	57906.1	52421.3	51131.7	52800.9	53429.2	148009.3	173182.1	178402.7	178171.8	174122.4	169772.4	160632.1
11	57559.2	52382.0	51118.8	52827.1	58970.9	148666.6	173581.1	178489.1	178114.1	173980.0	169633.4	160337.4
12	57215.0	52330.5	51080.3	52827.1	68737.0	149203.7	174008.5	178576.5	178056.5	173894.6	169411.0	160123.3
13	56870.7	52278.9	51042.3	52827.1	93931.4	149817.7	174350.5	178664.0	177969.8	173780.4	169355.5	159909.0
14	56526.5	52175.8	50991.5	52827.1	103801.5	150329.2	174663.9	178693.3	177854.5	173695.0	169216.3	159694.7
15	56212.7	52098.5	50966.1	52853.2	109593.6	150764.2	175034.4	178722.5	177767.9	173638.0	169077.4	159560.8
16	55887.9	52034.0	50940.7	52853.2	119929.9	151173.4	175348.1	178751.7	177681.4	173524.0	168938.4	159427.0
17	55576.7	52008.2	50928.0	52853.2	124208.3	151561.2	175690.8	178781.0	177623.7	173438.4	168771.6	159319.7
18	55252.0	51956.6	50890.0	52853.2	127159.0	151975.1	175921.4	178839.3	177537.0	173324.5	168688.1	159185.9
19	54915.5	51930.9	50826.5	52827.1	129367.2	152389.1	176210.0	178839.3	177479.4	173182.1	168549.2	159105.6
20	54649.3	51892.2	50750.3	52840.1	131204.1	152802.9	176412.0	178810.0	177392.8	173096.5	168354.6	158972.5
21	54423.0	51866.4	50712.3	52827.1	132399.1	153475.6	176614.0	178781.0	177306.3	172925.5	167854.2	158866.6
22	54143.6	51827.7	50699.6	52814.0	133692.9	154178.8	176815.8	178781.0	177219.7	172811.5	167464.9	158813.6
23	53877.4	51801.9	50674.2	52814.0	134712.8	156273.1	177017.8	178751.7	177162.1	172642.2	167022.3	158443.0
24	53691.0	51750.4	50636.2	52814.0	135711.5	158734.3	177219.7	178751.7	177046.6	172501.5	166583.0	158204.6
25	53560.1	51711.7	50598.1	52814.0	136474.5	160364.2	177392.8	178722.5	176931.3	172304.3	166171.0	157992.7
26	53442.3	51698.8	50560.0	52800.9	137220.7	161596.1	177537.0	178693.3	176815.8	172107.2	165731.6	157833.9
27	53285.2	51647.3	50534.6	52800.9	137918.7	162841.4	177594.8	178664.0	176729.3	171938.2	165292.3	157648.5
28	53167.4	51582.8	50750.3	52800.9	138496.3	164196.9	177710.1	178634.8	176585.1	171769.3	164853.0	157436.8
29	53036.5	51518.4	50991.5	52787.8	139078.6	165237.3	177767.9	178634.8	176469.6	171600.3	164413.9	157224.9
30	52892.5	51454.0	51221.9	52787.8		166116.0	177796.8	178605.7	176325.4	171459.6	164007.3	157066.0
31	52853.2		51312.1	52774.7		167104.6		178576.5		171290.4	163600.6	
Min	**52853.2**	**51454.0**	**50534.6**	**51299.2**	**52709.3**	**139614.7**	**167965.5**	**177825.6**	**176325.4**	**171290.4**	**163600.6**	**157066.0**
Max	**60908.3**	**52814.0**	**51389.5**	**52853.2**	**139078.6**	**167104.6**	**177796.8**	**178839.3**	**178547.2**	**176181.2**	**171121.5**	**163139.8**
Avg	**56239.4**	**52140.1**	**50994.6**	**52558.9**	**97268.1**	**152121.7**	**174423.9**	**178503.7**	**177659.2**	**173536.5**	**168293.9**	**159806.9**

CACHUMA RESERVOIR
STORAGE (Acre-feet)
Water Year 1993

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	156801.3	152828.8	150380.4	150713.0	191020.8	191449.1	191112.5	191112.5	191081.9	189652.8	186128.3	181322.2
2	156536.4	152725.4	150278.2	150866.5	191020.8	191387.9	191204.4	191204.4	191051.5	189531.8	186008.5	181234.5
3	156299.3	152621.8	150227.0	150917.7	191051.5	191449.1	191265.6	191173.8	191020.8	189410.7	185829.1	181147.0
4	156116.1	152570.2	150175.7	150968.7	190959.6	191387.9	191235.0	191173.8	191020.8	189259.5	185769.5	181000.8
5	155932.8	152492.5	150150.3	151019.9	190959.6	191357.3	191204.4	191204.4	191112.5	189108.3	185530.2	180854.8
6	155697.1	152389.1	150124.7	151019.9	190898.4	191418.5	191112.5	191173.8	191143.1	189017.4	185350.8	180708.8
7	155461.6	152311.4	150431.6	152130.3	190837.3	191173.8	191204.4	191081.9	191143.1	188926.8	185141.5	180504.3
8	155304.5	152259.6	150457.2	155409.1	192581.0	191265.6	191112.5	191020.8	191173.8	188835.9	184902.3	180387.5
9	155121.2	152182.1	150431.6	157569.1	191235.0	191235.0	191112.5	191081.9	191235.0	188745.3	184752.8	180270.5
10	154964.1	152130.3	150406.0	158390.0	191081.9	191020.8	191081.9	191173.8	191296.1	188624.2	184573.4	180124.5
11	154833.3	152052.8	150406.0	158919.6	191051.5	191051.5	191112.5	191143.1	191265.6	188533.5	184423.9	179949.3
12	154676.2	151975.1	150354.8	159453.8	191173.8	191112.5	191143.1	191143.1	191204.4	188442.7	184275.9	179832.5
13	154571.4	151897.6	150303.8	161596.1	191051.5	190990.2	191143.1	191143.1	191143.1	188321.8	184098.6	179744.8
14	154388.1	151819.9	150278.2	178287.2	190990.2	191051.5	191173.8	191143.1	191081.9	188231.1	183950.7	179511.2
15	154257.2	151742.3	150252.6	186277.7	191143.1	191204.4	191143.1	191112.5	191020.8	188170.5	183803.0	179365.0
16	154126.4	151690.5	150227.0	191724.3	191235.0	191296.1	191143.1	191081.9	190959.6	188019.3	183625.7	179248.3
17	153969.3	151587.1	150175.7	190653.8	191051.5	191326.7	191296.1	191051.5	190898.4	187928.5	183507.5	179131.5
18	153812.2	151509.4	150175.7	192183.3	191296.1	191265.6	191387.9	190990.2	190837.3	187807.6	183330.3	179073.0
19	153682.6	151199.0	150150.3	191265.6	193100.9	191204.4	191326.7	190990.2	190776.1	187686.4	183211.9	178927.0
20	153630.8	151147.8	150099.1	191112.5	191907.9	191112.5	191265.6	190990.2	190714.8	187565.5	183034.6	178781.0
21	153553.1	151173.4	150073.5	191081.9	191755.0	191020.8	191235.0	190990.2	190653.8	187444.6	182886.9	178634.8
22	153475.6	151122.2	150022.3	191204.4	191510.2	190990.2	191173.8	191020.8	190592.5	187294.2	182768.8	178518.0
23	153423.8	151071.1	149996.8	191020.8	192642.0	191173.8	191235.0	191081.9	190500.9	187174.7	182621.1	178402.7
24	153346.3	150968.7	149971.2	190990.2	191816.2	191296.1	191235.0	191173.8	190439.6	187085.1	182502.8	178258.3
25	153242.7	150892.1	149945.6	191020.8	191479.6	191846.6	191265.6	191204.4	190378.7	186965.4	182384.6	178114.1
26	153165.1	150789.8	149920.0	191265.6	191510.2	193162.2	191265.6	191204.4	190288.1	186845.8	182207.3	177998.7
27	153035.8	150713.0	149868.8	190990.2	191479.6	191418.5	191204.4	191173.8	190197.2	186666.4	182059.6	177912.1
28	152958.1	150636.3	149843.2	191020.8	191540.8	191265.6	191112.5	191112.5	190106.6	186546.7	181911.7	177739.0
29	152880.6	150559.5	150278.2	191173.8		191265.6	191112.5	191081.9	189985.5	186457.1	181734.4	177623.7
30	152854.7	150457.2	150585.1	191143.1		191143.1	191051.5	191081.9	189804.0	186367.3	181586.7	177479.4
31	152880.6		150687.4	190990.2		191326.7		191112.5		186217.9	181498.2	
Min	**152854.7**	**150457.2**	**149843.2**	**150713.0**	**190837.3**	**190990.2**	**191051.5**	**190990.2**	**189804.0**	**186217.9**	**181498.2**	**177479.4**
Max	**156801.3**	**152828.8**	**150687.4**	**192183.3**	**193100.9**	**193162.2**	**191387.9**	**191204.4**	**191296.1**	**189652.8**	**186128.3**	**181322.2**
Avg	**154354.8**	**151650.5**	**150215.4**	**175238.1**	**191406.5**	**191311.9**	**191189.1**	**191110.6**	**190804.2**	**187964.0**	**183722.9**	**179393.3**

CACHUMA RESERVOIR
STORAGE (Acre-feet)
Water Year 1994

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	177335.2	174208.0	172388.7	172388.7	171712.9	179569.5	181823.2	180913.2	179073.0	174892.0	167743.0	157595.6
2	177219.7	174094.1	172332.5	172360.5	171712.9	179686.5	181823.2	180884.0	178956.2	174692.5	167298.1	157277.9
3	177133.3	174037.0	172304.3	172360.5	171712.9	179774.0	181852.8	180854.8	178810.0	174492.9	166857.5	157013.0
4	177046.6	173923.1	172276.1	172332.5	171853.7	179832.5	181852.8	180825.5	178664.0	174321.9	166445.5	156801.3
5	176931.3	173837.5	172248.0	172276.1	171853.7	179861.7	181852.8	180767.2	178518.0	174179.5	166006.2	156536.4
6	176815.8	173780.4	172191.6	172219.8	171881.9	180007.7	181823.2	180708.8	178373.8	174037.0	165539.5	156299.3
7	176729.3	173695.0	172163.6	172191.6	172107.2	180241.5	181823.2	180621.0	178258.3	173866.0	165155.0	156037.4
8	176642.7	173638.0	172135.4	172163.6	172896.9	180270.5	181823.2	180621.0	178114.1	173752.1	164853.0	155775.7
9	176527.3	173552.6	172079.0	172107.2	173125.0	180329.0	181793.6	180562.7	177998.7	173581.1	164496.0	155513.8
10	176469.6	173495.5	172050.8	172079.0	173125.0	180387.5	181764.0	180504.3	177883.4	173409.9	164278.3	155252.1
11	176440.9	173467.0	172079.0	172050.8	173182.1	180387.5	181764.0	180475.0	177739.0	173238.9	164007.3	154964.1
12	176383.1	173409.9	172416.9	171994.4	173210.6	180445.8	181734.4	180416.7	177652.5	173039.6	163763.3	154676.2
13	176296.5	173353.0	172473.3	171938.2	173210.6	180475.0	181675.5	180358.3	177537.0	172868.6	163465.1	154414.3
14	176210.0	173267.5	172501.5	171881.9	173210.6	180504.3	181645.9	180299.8	177421.7	172670.4	163221.0	154152.6
15	176123.4	173210.6	172585.9	171797.5	173238.9	180533.5	181616.3	180241.5	177306.3	172529.5	162922.8	153916.9
16	176036.9	173125.0	172585.9	171712.9	173238.9	180504.3	181557.1	180153.8	177219.7	172416.9	162624.7	153708.3
17	175950.3	173067.9	172585.9	171628.5	173723.6	180475.0	181498.2	180066.2	177075.5	172219.8	162299.4	153449.7
18	175863.8	173011.1	172585.9	171572.1	173980.0	180475.0	181468.6	180095.3	176960.2	172050.8	161974.1	153242.7
19	175777.2	172954.0	172557.7	171544.0	174122.4	180504.3	181409.8	180066.2	176844.7	171881.9	161676.4	153035.8
20	175690.8	172896.9	172557.7	171459.6	175690.8	180592.0	181351.3	180007.7	176729.3	171712.9	161328.2	152828.8
21	175604.5	172840.1	172557.7	171431.4	177623.7	180621.0	181263.8	179920.0	176585.1	171515.8	161006.9	152621.8
22	175234.0	172783.0	172529.5	171403.2	178344.9	180592.0	181176.0	179861.7	176383.1	171346.8	160712.3	152414.8
23	175405.0	172754.8	172501.5	171487.6	178751.7	180592.0	181088.5	179803.3	176238.9	171177.9	160417.8	152233.9
24	175262.5	172670.4	172501.5	171515.8	178956.2	180650.3	181030.0	179744.8	176036.9	171008.9	160069.7	152078.7
25	175120.0	172642.2	172473.3	171712.9	179073.0	181176.0	181000.8	179686.5	175892.7	170840.0	159775.1	151897.6
26	175006.1	172585.9	172473.3	171769.3	179219.0	181409.8	181030.0	179598.8	175748.3	170445.7	159427.0	151716.4
27	174863.4	172501.5	172473.3	171797.5	179336.0	181498.2	181000.8	179482.0	175604.5	169967.0	159078.8	151561.2
28	174749.5	172473.3	172473.3	171797.5	179452.7	181586.7	181000.8	179394.3	175433.5	169522.3	158813.6	151380.1
29	174436.1	172360.5	172473.3	171797.5		181675.5	180971.7	179336.0	175262.5	169105.2	158469.5	151224.9
30	174436.1	172416.9	172445.1	171741.1		181705.0	180942.5	179248.3	175091.5	168632.7	158178.1	151045.5
31	174293.6		172416.9	171741.1		181764.0		179160.5		168187.8	157886.9	
Min	**174293.6**	**172360.5**	**172050.8**	**171403.2**	**171712.9**	**179569.5**	**180942.5**	**179160.5**	**175091.5**	**168187.8**	**157886.9**	**151045.5**
Max	**177335.2**	**174208.0**	**172585.9**	**172388.7**	**179452.7**	**181764.0**	**181852.8**	**180913.2**	**179073.0**	**174892.0**	**167743.0**	**157595.6**
Avg	**175936.6**	**173201.8**	**172400.6**	**171879.2**	**174626.7**	**180584.8**	**181481.9**	**180150.9**	**177180.4**	**172180.8**	**162573.9**	**154022.2**

CACHUMA RESERVOIR
STORAGE (Acre-feet)
Water Year 1995

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	150866.5	146139.3	143891.6	142531.5	160283.9	144141.4	143741.8	143816.8	144840.5	144466.1	141668.1	138111.3
2	150687.4	145989.2	143816.8	142506.8	158734.3	144241.3	143791.8	143791.8	144940.5	144341.1	141544.7	137966.8
3	150508.3	145864.4	143766.8	142679.5	157119.0	144191.3	143741.8	143791.8	145040.3	144191.3	141446.0	137822.4
4	150431.6	145789.4	143692.0	142950.9	155985.2	144116.4	143692.0	143791.8	145140.1	144041.5	141347.4	137702.1
5	150380.4	145664.6	143642.0	143941.6	154780.9	144316.2	143816.8	143791.8	145215.1	143941.6	141224.1	137533.6
6	150278.2	145589.6	143592.3	144116.4	153630.8	148666.6	143816.8	143791.8	145290.0	143816.8	141101.2	137437.2
7	150175.7	145514.8	143567.6	144366.1	152492.5	147984.0	143791.8	143791.8	145290.0	143741.8	141003.8	137316.9
8	150073.5	145464.8	143493.7	144565.9	151328.3	145240.1	143766.8	143816.8	145339.9	143741.8	140882.0	137172.5
9	149945.6	145364.9	143444.3	145714.6	150073.5	143617.0	143716.8	143841.8	145389.9	143667.0	140784.4	137028.1
10	149792.1	145414.8	143394.9	157569.1	148692.2	143791.8	143916.6	143891.6	145439.8	143617.0	140662.6	136931.8
11	149587.5	145339.9	143321.0	187807.6	147276.5	165539.5	143866.6	143941.6	145514.8	143567.6	140540.8	136787.4
12	149357.3	145265.0	143296.3	189108.3	146265.6	174265.1	143816.8	143866.6	145564.7	143493.7	140418.9	136667.1
13	149101.4	145165.1	143271.6	186666.4	144965.3	172925.5	143766.8	143891.6	145564.7	143394.9	140297.1	136546.6
14	148845.7	145140.1	143222.3	183537.1	145414.8	169272.0	144291.2	143991.6	145589.6	143321.0	140175.1	136450.4
15	148590.4	145065.3	143197.7	181234.5	147579.7	163898.8	144366.1	144191.3	145564.7	143246.9	140053.3	136330.1
16	148312.5	144990.3	143148.3	178634.8	147276.5	158628.4	144216.3	144615.9	145539.7	143148.3	139931.5	136234.6
17	148110.3	144890.5	143098.9	176036.9	146467.8	153165.1	144016.5	144740.7	145539.7	143049.6	139834.1	136139.5
18	147933.4	144840.5	143024.9	173353.0	145464.8	148896.7	143966.6	144790.5	145539.7	142926.2	139712.1	136044.5
19	147756.6	144740.7	143000.3	170811.8	144490.9	146215.0	143816.8	144890.5	145489.8	142852.2	139614.7	135925.6
20	147579.7	144665.7	142975.6	168688.1	143716.8	144466.1	143791.8	144940.5	145464.8	142778.2	139541.6	135830.4
21	147503.8	144615.9	142926.2	167437.3	143518.4	144016.5	143816.8	144965.3	145389.9	142679.5	139419.7	135735.3
22	147377.5	144590.9	142852.2	165182.5	143469.0	143816.8	143866.6	144940.5	145339.9	142605.6	139297.9	135640.1
23	147251.2	144515.9	142802.8	163221.0	143592.3	146619.4	143841.8	144965.3	145290.0	142531.5	139176.0	135545.0
24	147124.9	144391.1	142753.6	166665.3	143766.8	145639.6	143841.8	145040.3	145215.1	142457.6	139078.6	135473.8
25	146998.4	144316.2	142778.2	189108.3	143916.6	143841.8	143716.8	145115.1	145140.1	142358.8	138956.6	135331.1
26	146872.1	144241.3	142728.9	191510.2	144066.4	143716.8	143716.8	145115.1	145040.3	142284.9	138834.8	135235.9
27	146745.8	144141.4	142679.5	184932.2	144166.3	143866.6	143791.8	145065.3	144940.5	142186.1	138713.0	135140.8
28	146644.7	144066.4	142630.1	179540.3	144191.3	143816.8	143791.8	144965.3	144840.5	142136.9	138616.8	135045.6
29	146518.3	144016.5	142630.1	174065.5		143741.8	143866.6	144865.5	144715.7	141988.8	138496.3	134950.5
30	146366.6	143966.6	142580.9	168382.4		143866.6	143866.6	144765.7	144590.9	141890.1	138376.0	134855.5
31	146265.6		142580.9	162841.4		143841.8		144790.5			138255.7	
Min	**146265.6**	**143966.6**	**142580.9**	**142506.8**	**143469.0**	**143617.0**	**143692.0**	**143791.8**	**144590.9**	**141890.1**	**138255.7**	**134855.5**
Max	**150866.5**	**146139.3**	**143891.6**	**191510.2**	**160283.9**	**174265.1**	**144366.1**	**145115.1**	**145589.6**	**144466.1**	**141668.1**	**138111.3**
Avg	**148515.6**	**144992.0**	**143154.9**	**166442.2**	**148311.7**	**149495.6**	**143860.9**	**144405.6**	**145260.0**	**143148.8**	**139967.9**	**136364.4**

CACHUMA RESERVOIR
STORAGE (Acre-feet)
Water Year 1996

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	134712.8	131740.7	129809.0	128584.3	127963.6	143892.0	150994.3	151457.6	148692.2	144765.7	136068.0	127205.0
2	134593.9	131693.6	129739.3	128515.3	128078.5	144166.3	151173.4	151354.2	148615.7	144590.9	135759.0	126975.0
3	134522.5	131646.6	129646.2	128492.3	128331.3	144341.1	151250.8	151276.7	148540.0	144416.1	135426.0	126748.0
4	134356.0	131576.0	129576.5	128423.4	128492.3	144615.9	151354.2	151173.4	148438.8	144241.3	135117.0	126520.0
5	134261.0	131529.5	129483.5	128354.4	128561.3	144890.5	151457.6	151045.5	148287.2	144091.4	134784.0	126270.0
6	134118.3	131459.8	129413.8	128262.5	128791.2	145115.1	151535.3	150943.3	148160.9	143891.6	134475.0	126043.0
7	133975.6	131390.0	129367.2	128262.5	128906.1	145339.9	151535.3	150815.2	148034.6	143766.8	134166.0	125816.0
8	133857.4	131343.6	129320.8	128216.4	128929.1	145514.8	151612.8	150687.4	147933.4	143493.7	133834.0	125589.0
9	133763.3	131250.5	129251.0	128124.5	128975.1	145689.6	151638.8	150559.5	147832.3	143321.0	133552.0	125362.0
10	133622.2	131180.8	129182.0	128078.5	128975.1	145814.4	151638.8	150482.7	147655.4	143148.3	133246.0	125021.0
11	133528.2	131111.0	129113.1	127986.6	128998.1	145939.2	151638.8	150380.4	147529.1	143000.3	133011.0	124794.0
12	133434.0	131064.6	129159.1	127940.6	128998.1	146114.0	151664.6	150329.2	147377.5	142827.6	132728.0	124545.0
13	133363.6	130948.2	129159.1	127848.6	129021.2	146771.1	151664.6	150252.6	147225.9	142679.5	132423.0	124276.0
14	133269.4	130878.5	129090.1	127779.6	129021.2	147529.1	151690.5	150175.7	147099.6	142531.5	132140.0	124029.0
15	133175.3	130832.0	129090.1	127733.7	129021.2	147958.7	151690.5	150073.5	146973.3	142358.8	131858.0	123827.0
16	133081.3	130739.0	128998.1	127664.7	129067.0	148337.8	151716.4	150047.9	146846.8	142186.1	131576.0	123579.0
17	132987.1	130669.2	128975.1	127687.7	129021.2	148666.6	151716.4	149996.8	146720.5	142013.4	131297.0	123332.0
18	132916.7	130622.8	128929.1	127618.7	129021.2	148922.3	151716.4	149920.0	146619.4	141840.8	131018.0	123108.0
19	132846.0	130553.0	128883.2	127595.8	129021.2	149152.6	151794.0	149817.7	146442.5	141446.0	130716.0	122883.0
20	132775.6	130506.5	128860.2	127572.8	131670.0	149382.8	151768.1	149740.9	146290.9	140979.4	130460.0	122614.0
21	132728.5	130436.8	128814.2	127503.7	136931.8	149587.5	151768.1	149689.7	146164.6	140565.1	130158.0	122390.0
22	132610.9	130390.2	128883.2	127480.7	139517.3	149766.5	151794.0	149561.8	145989.2	140102.1	129856.0	122146.0
23	132516.9	130343.7	128860.2	127434.8	140857.6	149868.8	151794.0	149485.2	145839.4	139663.5	129600.0	121946.0
24	132422.7	130297.3	128860.2	127342.8	141618.7	150073.5	151794.0	149408.4	145714.6	139200.4	129321.0	121746.0
25	132305.1	130250.7	128837.2	127388.8	142112.2	150201.3	151768.1	149306.1	145564.7	138761.8	128975.0	121502.0
26	132211.1	130181.1	128814.2	127365.8	142580.9	150329.2	151768.1	149254.9	145414.8	138327.9	128653.0	121302.0
27	132116.9	130134.5	128745.3	127342.8	142901.6	150431.6	151716.4	149178.2	145290.0	137918.7	128331.0	121080.0
28	132046.4	130041.6	128791.2	127365.8	143370.4	150585.1	151664.6	149101.4	145140.1	137461.3	128079.0	120881.0
29	131952.3	129995.0	128699.3	127342.8	143741.8	150687.4	151612.8	148999.2	144990.3	137028.1	127872.0	120681.0
30	131858.2	129925.2	128584.3	127342.8		150789.8	151535.3	148871.3	144890.5	136715.2	127665.0	120503.0
31	131787.8		128584.3			150892.1		148768.9		136402.2	127435.0	
Min	**131787.8**	**129925.2**	**128584.3**	**127342.8**	**127963.6**	**143892.0**	**150994.3**	**148768.9**	**144890.5**	**136402.2**	**127435.0**	**120503.0**
Max	**134712.8**	**131740.7**	**129809.0**	**128584.3**	**143741.8**	**150892.1**	**151794.0**	**151457.6**	**148692.2**	**144765.7**	**136068.0**	**127205.0**
Avg	**133152.2**	**130824.4**	**129081.3**	**127821.8**	**132844.7**	**147786.0**	**151615.6**	**150069.5**	**146877.1**	**141410.9**	**131600.0**	**123757.1**

Inflow to Cachuma Reservoir

CACHUMA RESERVOIR
INFLOW (Acre-feet)
Water Year 1991

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	7.61	0.16	4.98	31.33	-10.07	95.26	1216.23	122.30	34.35	94.00	4.26	31.60
2	19.22	-5.76	6.70	18.00	17.24	382.16	885.24	72.28	66.09	56.15	29.53	-10.01
3	-3.69	10.30	12.77	13.32	-5.49	86.65	761.78	117.02	54.54	52.68	-4.02	-35.97
4	18.13	3.30	2.45	19.32	-107.87	11.61	772.68	91.05	29.20	38.22	9.58	72.21
5	21.79	8.35	10.91	8.27	140.40	241.31	743.21	155.06	40.61	45.79	15.15	21.07
6	30.56	18.09	0.78	10.66	25.34	86.27	689.07	136.45	26.67	36.02	-3.05	13.73
7	16.53	3.98	9.45	26.36	11.41	36.65	584.30	117.99	20.20	53.16	18.61	11.24
8	4.33	-3.96	11.81	4.62	4.09	16.60	562.17	106.82	33.39	31.91	28.10	14.49
9	21.95	18.21	13.64	21.66	6.00	9.78	542.70	7.53	41.51	18.69	19.26	8.76
10	13.74	38.34	4.86	-14.90	8.77	7.78	355.58	100.09	27.49	20.15	35.49	7.28
11	29.02	8.08	7.60	16.37	15.75	-0.81	419.79	99.65	21.70	18.07	13.49	-4.71
12	-1.42	15.19	14.54	-1.16	14.77	8.31	323.91	110.27	15.49	13.75	21.34	19.79
13	5.61	7.86	10.53	17.73	3.32	12.36	260.26	90.47	14.24	8.42	37.30	6.02
14	0.12	-3.96	-15.23	31.08	33.70	-16.34	317.95	80.85	-8.02	14.71	19.34	13.50
15	10.41	11.46	-3.36	-7.66	1.48	-0.76	254.95	82.51	20.72	26.50	8.57	8.06
16	-2.95	17.34	-21.06	4.51	21.58	3.29	349.32	111.61	25.83	14.67	28.90	-6.91
17	7.21	10.34	-3.81	6.34	-20.49	23.45	255.72	65.57	5.17	9.91	0.60	41.74
18	20.98	3.23	24.78	0.80	16.97	312.37	232.99	-8.78	10.07	22.02	-13.86	14.21
19	4.56	5.53	27.39	-0.60	11.30	8586.44	223.14	61.37	-17.82	5.11	30.76	5.57
20	-8.01	-8.09	-14.65	13.17	20.38	5577.08	79.09	61.03	-36.50	9.32	9.44	10.06
21	13.36	-0.22	1.38	14.18	11.29	3635.56	214.92	94.88	-3.83	21.25	1.34	20.58
22	16.55	15.77	6.18	8.06	20.22	1715.71	271.20	57.59	-5.58	13.23	-2.29	12.20
23	5.15	20.54	3.78	-1.96	6.01	908.30	187.10	60.81	0.95	26.75	18.80	21.29
24	28.02	19.36	6.92	7.66	1.04	774.68	171.10	83.04	5.71	16.24	18.06	4.50
25	23.04	-6.68	19.71	3.25	3.54	946.29	161.90	68.44	-16.66	17.73	20.67	25.50
26	1.96	6.43	16.07	16.38	19.02	1147.95	157.30	32.30	20.40	7.27	41.90	13.07
27	15.12	-0.38	18.71	-6.94	20.29	2164.45	201.80	15.09	25.73	16.14	-9.74	-2.05
28	9.93	6.43	10.67	24.15	23.54	4416.25	157.10	42.84	43.40	14.46	-44.66	-6.70
29	10.61	5.45	8.01	-12.47		1776.78	171.21	28.57	49.91	21.16	63.95	9.50
30	4.16	20.79	0.11	24.87		1685.86	137.62	30.22	50.90	27.78	42.75	10.22
31	2.63		15.79	6.82		1322.17		10.09		16.14	14.31	
Min	**-8.01**	**-8.09**	**-21.06**	**-14.90**	**-107.87**	**-16.34**	**79.09**	**-8.78**	**-36.50**	**5.11**	**-44.66**	**-35.97**
Max	**30.56**	**38.34**	**27.39**	**31.33**	**140.40**	**8586.44**	**1216.23**	**155.06**	**66.09**	**94.00**	**63.95**	**72.21**
Avg	**11.17**	**8.18**	**6.85**	**9.78**	**11.20**	**1160.43**	**388.71**	**74.36**	**19.86**	**25.40**	**15.29**	**11.66**

CACHUMA RESERVOIR
INFLOW (Acre-feet)
Water Year 1992

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	-7.60	6.90	-18.44	19.49	5.90	593.49	887.47	169.92	90.83	2.87	15.64	-54.60
2	13.37	7.34	17.90	7.00	14.21	512.80	792.45	185.15	73.71	39.64	18.01	31.81
3	10.03	24.12	-10.36	47.88	19.76	1009.02	782.67	192.10	77.63	-4.61	40.43	3.88
4	1.19	21.48	31.18	4.61	38.84	716.28	700.24	189.01	37.36	-16.84	-18.47	-31.95
5	9.43	26.00	34.79	85.19	32.51	682.34	639.75	163.22	76.99	-4.09	27.43	34.16
6	4.40	36.38	1.14	734.87	0.96	1129.69	612.37	173.39	60.51	41.38	3.09	18.03
7	27.98	25.93	14.83	222.26	32.81	1715.56	576.36	138.64	17.56	-3.11	-12.00	-24.13
8	-10.88	12.01	-9.60	97.32	18.36	946.56	592.21	200.77	15.13	12.11	71.42	-12.09
9	31.57	23.75	0.12	84.63	22.18	770.41	518.70	107.26	48.01	40.62	-4.95	7.77
10	20.87	-3.85	13.88	60.71	370.03	713.15	515.88	205.61	62.83	42.59	62.73	-14.35
11	40.02	10.27	25.31	50.59	5336.92	699.52	463.58	183.80	29.41	14.93	27.89	-31.11
12	4.67	15.20	0.28	24.60	9213.51	577.00	491.01	135.49	14.30	46.42	-20.30	22.12
13	14.16	12.41	5.46	16.85	25051.67	654.55	407.40	154.39	25.42	16.47	89.15	14.26
14	17.22	-33.01	-7.81	23.96	9891.10	553.61	381.34	129.89	2.62	5.38	39.48	-7.83
15	13.78	-21.63	22.22	44.12	5466.23	471.39	437.03	117.89	13.70	52.53	29.46	44.75
16	4.90	-15.14	19.16	23.54	10361.19	449.64	388.59	120.59	21.33	-5.38	40.32	-9.04
17	16.33	18.07	33.87	20.69	4312.92	436.51	413.41	138.00	43.54	32.99	-1.23	6.02
18	6.28	-25.65	8.92	21.41	2994.39	474.37	319.40	159.84	24.10	12.97	89.07	-17.81
19	2.61	20.90	-12.88	-6.86	2252.03	455.10	385.11	104.11	65.33	-10.51	46.90	43.04
20	-11.09	9.96	-28.42	32.65	1866.14	434.45	300.97	97.00	36.04	40.13	1.62	-1.48
21	11.74	19.85	6.49	13.07	1232.02	590.59	287.10	76.61	37.44	-52.11	-50.76	22.57
22	-25.20	5.77	32.83	10.50	1344.46	696.61	295.43	119.18	31.04	30.01	46.96	72.75
23	-20.75	18.15	19.11	24.25	1073.58	1813.18	301.03	77.53	80.87	1.81	-4.22	-46.21
24	-38.26	-0.88	7.25	21.33	1045.92	2498.83	286.13	116.84	23.43	47.58	-16.31	3.34
25	11.56	8.94	0.61	27.97	822.88	1671.53	267.29	82.13	10.77	-11.38	15.92	-29.96
26	23.49	35.74	0.70	15.01	798.30	1264.25	284.37	77.12	18.57	7.44	2.27	34.24
27	-67.00	-2.04	18.11	25.40	756.48	1261.34	208.58	72.08	52.69	18.87	-1.20	18.06
28	22.51	-14.12	-12.93	30.60	646.33	1383.72	252.90	52.90	-7.63	22.59	-4.32	-25.98
29	16.35	-14.28	49.47	17.06	627.36	1078.41	199.63	84.41	31.45	0.44	-15.03	12.92
30	-0.66	-11.43	104.55	28.89		917.07	187.42	50.85	7.24	23.50	6.33	68.90
31	19.33		108.22	17.07		911.74		71.83		12.39	14.07	
Min	**-67.00**	**-33.01**	**-28.42**	**-6.86**	**0.96**	**434.45**	**187.42**	**50.85**	**-7.63**	**-52.11**	**-50.76**	**-54.60**
Max	**40.02**	**36.38**	**108.22**	**734.87**	**25051.67**	**2498.83**	**887.47**	**205.61**	**90.83**	**52.53**	**89.15**	**72.75**
Avg	**5.24**	**7.24**	**15.35**	**59.57**	**2953.41**	**905.89**	**439.19**	**127.34**	**37.41**	**14.76**	**17.40**	**5.07**

CACHUMA RESERVOIR
INFLOW (Acre-feet)
Water Year 1993

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	-39.11	-8.34	1.96	44.04	789.87	3971.70	2372.19	536.63	198.77	57.00	90.16	-34.21
2	-41.34	-57.11	-22.51	19.68	755.44	3537.07	2176.10	528.79	204.25	78.00	70.28	57.47
3	-36.22	-23.77	23.05	76.08	783.13	3161.06	1947.45	424.18	217.28	78.00	-13.34	49.69
4	8.26	31.59	-32.56	80.93	662.66	2978.84	1753.37	430.78	206.59	45.00	111.86	21.82
5	4.26	0.62	10.27	77.04	690.72	2487.86	1666.97	452.29	189.64	24.00	-32.07	3.86
6	-20.18	-30.63	17.05	12.03	605.58	2370.76	1420.90	408.42	226.64	102.00	40.04	8.61
7	-45.50	-1.71	-91.51	830.66	614.28	2174.01	1529.75	348.87	209.99	70.00	21.86	-61.11
8	380.17	17.50	-1.77	3210.06	3126.94	2000.46	1342.56	382.50	197.17	74.00	-22.78	50.91
9	-13.07	-8.77	4.58	2169.39	12582.54	2013.36	1320.25	423.60	220.16	68.00	47.13	33.82
10	-0.51	14.86	-1.97	842.83	4893.93	1448.83	1171.09	427.97	236.31	32.00	34.23	12.03
11	25.79	-9.87	-39.15	500.27	3079.78	1457.01	1141.45	350.71	174.68	62.00	30.12	-1.90
12	-9.17	-1.45	-45.10	585.81	2305.04	1423.72	1128.69	380.71	155.61	57.00	19.88	46.89
13	32.00	-7.93	-16.41	1507.67	2088.64	1201.78	1046.34	407.77	162.42	21.00	-2.58	56.40
14	-47.83	2.17	-0.13	16286.77	1841.90	1123.21	1006.97	330.16	152.29	54.00	29.36	-72.41
15	11.28	1.68	5.67	8020.42	1590.89	1216.73	879.46	323.45	167.72	67.00	15.13	-14.95
16	2.74	14.45	7.37	6495.55	1444.83	1149.92	814.32	350.58	134.12	26.00	0.12	-7.74
17	-11.08	-38.81	-20.37	4272.91	1271.84	1074.40	914.50	344.03	149.75	84.00	42.45	-27.13
18	-19.91	4.18	1.70	10088.49	1368.62	976.04	846.19	328.78	134.59	54.00	0.86	72.39
19	1.76	-216.50	4.54	9276.17	10757.97	996.97	764.57	321.89	132.03	42.00	48.00	-16.24
20	29.41	42.78	-22.18	4716.01	12833.97	958.88	754.80	316.45	124.21	55.00	-14.78	-22.68
21	-16.75	126.21	2.55	2682.95	7915.36	892.08	764.29	256.04	83.89	65.00	32.33	-16.13
22	-26.48	16.15	-23.06	2405.59	5170.88	807.94	643.62	269.08	95.74	31.00	48.68	1.80
23	22.56	10.27	4.83	1755.30	6659.40	776.06	649.08	301.37	80.97	41.00	23.07	11.65
24	20.59	-36.52	5.65	1644.41	14801.15	713.92	606.88	296.10	130.37	83.00	44.24	-9.56
25	0.76	-11.26	12.29	1212.66	7365.81	921.01	615.90	282.88	149.55	49.00	52.60	6.53
26	23.26	-22.55	6.75	1323.30	5559.06	13966.80	580.87	280.93	114.88	44.00	-12.19	29.13
27	-22.62	5.83	-17.58	986.07	5901.70	6311.67	539.60	300.98	102.94	-38.00	47.08	72.09
28	4.34	9.05	5.78	846.12	4717.20	4629.26	509.57	236.30	102.96	32.00	39.23	-17.25
29	13.38	5.43	38.78	958.96		3969.23	593.91	247.11	85.17	71.00	25.23	49.17
30	-56.47	-23.07	268.28	846.56		3204.50	449.93	238.76	47.48	70.19	23.68	-18.79
31	-1.31		129.83	773.58		2768.69		268.19		28.61	56.27	
Min	**-56.47**	**-216.50**	**-91.51**	**12.03**	**605.58**	**713.92**	**449.93**	**236.30**	**47.48**	**-38.00**	**-32.07**	**-72.41**
Max	**380.17**	**126.21**	**268.28**	**16286.77**	**14801.15**	**13966.80**	**2372.19**	**536.63**	**236.31**	**102.00**	**111.86**	**72.39**
Avg	**5.58**	**-6.52**	**6.99**	**2727.36**	**4363.54**	**2473.67**	**1065.05**	**348.27**	**152.94**	**52.48**	**28.91**	**8.81**

CACHUMA RESERVOIR
INFLOW (Acre-feet)
Water Year 1994

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	-3.00	39.26	35.19	14.47	9.91	189.88	144.47	50.70	35.52	29.09	6.60	-7.00
2	-0.98	-14.30	-1.30	11.16	40.07	192.42	86.26	43.98	35.00	7.33	-15.00	-22.18
3	19.28	33.01	23.09	41.88	40.36	161.13	115.29	54.67	11.22	-5.20	3.90	-26.05
4	16.49	-34.46	24.42	39.74	6.41	120.71	80.13	53.67	18.31	24.44	24.20	43.17
5	-15.06	-1.67	14.21	-0.33	38.00	100.70	88.21	34.46	17.08	12.82	6.40	-14.34
6	-11.98	24.68	-9.41	14.59	70.33	91.03	50.25	35.42	11.63	5.67	15.30	15.04
7	8.16	-3.82	12.33	30.88	-94.40	244.83	95.66	8.51	40.33	-22.94	1.40	-6.40
8	6.68	25.08	16.51	30.53	559.56	89.31	90.60	0.98	18.61	36.67	42.30	-1.41
9	-13.88	-13.84	-12.08	-2.52	271.40	126.28	14.63	52.17	51.61	9.27	-16.82	1.01
10	31.89	14.77	18.97	23.84	38.71	126.68	53.66	50.10	51.49	19.39	55.97	-6.28
11	-5.59	-54.20	49.17	30.80	96.24	72.23	92.17	49.15	33.80	18.73	0.15	11.68
12	20.89	20.26	1.53	10.22	84.43	120.09	72.79	29.60	63.30	-3.69	34.88	-31.06
13	7.82	5.68	82.09	27.73	42.62	91.55	43.86	30.02	45.44	20.67	-6.27	4.92
14	2.59	-25.93	56.39	28.91	53.00	110.03	73.85	29.01	19.79	-14.19	68.13	-15.99
15	9.78	7.42	-27.41	19.01	81.63	123.20	62.56	44.63	23.67	20.35	30.53	7.08
16	3.57	-21.53	28.92	17.88	59.82	70.19	45.73	13.13	52.49	41.82	47.50	47.24
17	-1.70	1.35	27.65	10.91	145.72	64.02	28.83	9.79	-7.23	-37.81	8.91	-26.52
18	-2.76	7.63	33.26	56.54	254.56	66.86	65.21	19.65	24.05	-0.87	7.08	20.27
19	9.74	3.07	-7.43	30.63	132.83	46.94	69.36	-11.06	23.89	11.64	13.18	15.31
20	11.78	2.77	26.34	-15.23	1159.18	62.26	57.96	27.53	20.62	30.41	-0.37	9.76
21	20.09	16.13	32.72	26.32	1966.77	91.31	32.80	13.56	10.39	-26.90	15.37	-10.30
22	-287.37	-8.42	2.51	24.73	770.67	28.15	36.97	37.98	2.63	2.55	9.30	-17.85
23	310.96	28.86	0.75	43.28	452.79	63.26	12.61	39.70	60.19	-4.69	3.81	-22.64
24	6.87	-15.91	28.27	51.86	253.00	98.68	0.18	38.38	10.15	-3.26	-28.11	20.21
25	-20.32	30.42	-1.45	1.86	186.98	182.25	61.68	35.80	31.61	-5.05	59.57	3.51
26	40.82	12.04	27.74	66.97	210.00	281.67	0.80	15.85	36.80	56.47	-36.77	3.47
27	31.10	-16.13	24.56	53.50	173.22	139.31	38.49	-1.61	43.36	-14.35	-2.61	9.88
28	4.81	39.27	28.27	29.20	177.11	137.33	-10.87	21.73	16.21	-9.06	41.37	1.16
29	-177.55	-34.50	36.74	29.89		145.75	52.74	62.73	28.22	26.75	-32.95	-2.99
30	150.28	-34.92	14.37	-15.97		90.95	50.85	38.23	39.18	-0.71	7.41	7.18
31	5.80		17.34	45.50		118.33		30.04		-15.05	2.67	
Min	**-287.37**	**-54.20**	**-27.41**	**-15.97**	**-94.40**	**28.15**	**-10.87**	**-11.06**	**-7.23**	**-37.81**	**-36.77**	**-31.06**
Max	**310.96**	**39.27**	**82.09**	**66.97**	**1966.77**	**281.67**	**144.47**	**62.73**	**63.30**	**56.47**	**68.13**	**47.24**
Avg	**5.78**	**1.07**	**19.49**	**25.12**	**260.03**	**117.66**	**56.92**	**30.92**	**28.98**	**6.78**	**11.84**	**0.33**

CACHUMA RESERVOIR
INFLOW (Acre-feet)
Water Year 1995

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	3.22	2.44	-1.11	-15.57	2055.00	647.07	1977.37	514.71	207.66	98.06	67.59	11.63
2	19.99	-26.74	-9.82	9.65	1778.80	728.95	1904.37	516.43	216.17	95.87	32.36	20.49
3	-7.00	-35.22	13.89	-79.74	1404.40	702.58	1829.70	525.71	228.85	67.59	45.91	20.74
4	22.22	5.99	-22.54	94.08	1261.20	748.27	1672.50	464.29	239.63	65.96	57.25	47.78
5	-63.14	-46.56	14.90	440.26	1132.10	926.48	1627.19	499.50	224.10	85.74	42.71	-1.72
6	9.15	4.92	2.45	195.66	997.00	7733.61	1483.25	476.03	243.09	80.89	35.69	51.97
7	19.51	4.26	14.98	51.79	911.20	3959.96	1387.46	423.78	161.96	66.76	54.28	29.98
8	16.81	9.60	-23.20	216.24	945.70	2282.13	1300.36	443.70	205.97	132.08	31.73	-2.34
9	-0.97	-7.65	-4.99	845.91	893.70	1854.11	1111.12	413.56	204.37	66.42	48.55	-8.42
10	-27.95	-40.86	-1.04	11366.33	944.10	1688.71	1251.64	454.51	201.66	73.36	21.92	39.39
11	14.53	20.94	-24.45	33804.49	760.40	27559.35	1154.85	435.79	227.29	72.13	27.80	-9.91
12	13.52	-14.52	17.51	7647.70	759.80	18425.54	1098.34	332.89	201.01	38.71	27.94	9.11
13	-19.62	-51.47	1.93	3890.59	723.20	8523.48	999.07	430.22	164.77	37.83	33.52	0.47
14	-23.93	20.22	-3.45	2010.02	193.10	5621.66	949.44	389.51	207.62	88.35	51.17	18.06
15	-24.43	-12.05	2.84	1700.42	4257.50	4288.22	959.14	394.09	149.12	87.51	40.63	-3.61
16	-41.38	-42.61	1.41	1379.66	1819.30	3491.25	878.50	775.87	155.18	66.62	30.22	23.33
17	28.32	-41.43	-3.32	941.77	1316.00	2914.19	899.67	532.90	139.06	31.84	24.98	20.74
18	0.04	-1.08	-24.65	666.72	1091.00	2542.05	824.71	443.16	210.70	42.03	6.13	24.01
19	-1.34	-44.89	21.86	526.33	1104.10	2377.76	787.62	449.67	169.20	53.54	27.96	3.32
20	-42.79	-18.41	21.56	639.17	907.10	2172.62	759.56	427.73	189.61	57.38	59.87	20.22
21	52.22	13.73	7.80	810.07	913.70	2223.75	763.59	390.91	153.52	31.81	7.95	12.67
22	-2.48	28.47	-15.80	803.00	890.80	2798.61	756.36	330.78	178.49	49.98	29.49	16.29
23	-10.44	-4.67	4.02	614.00	814.80	7343.66	696.77	327.83	172.72	48.82	44.14	13.34
24	-15.71	-27.89	9.49	7386.00	805.30	9835.14	696.81	331.68	162.50	52.44	56.65	34.14
25	5.69	10.72	-60.24	27805.16	771.90	4824.98	696.17	338.92	162.31	32.60	44.17	-39.69
26	9.19	-34.78	8.72	15516.20	766.70	3917.14	557.00	377.86	130.08	68.40	6.93	5.68
27	13.71	-15.69	-1.48	5609.40	728.00	3413.81	704.68	361.02	124.79	40.20	3.27	7.85
28	27.09	15.06	-19.71	3564.14	691.20	2941.72	608.67	308.09	119.97	116.05	38.87	7.41
29	3.59	9.16	27.93	2574.30		2683.94	628.93	309.30	102.75	29.04	9.66	5.91
30	-16.71	12.93	-15.72	2053.11		2466.40	573.44	309.09	96.10	83.46	47.53	21.18
31	25.84		37.81	1760.97		2243.97		268.39		61.22	28.90	
Min	**-63.14**	**-51.47**	**-60.24**	**-79.74**	**193.10**	**647.07**	**557.00**	**268.39**	**96.10**	**29.04**	**3.27**	**-39.69**
Max	**52.22**	**28.47**	**37.81**	**33804.49**	**4257.50**	**27559.35**	**1977.37**	**775.87**	**243.09**	**132.08**	**67.59**	**51.97**
Avg	**-0.43**	**-10.27**	**-0.72**	**4349.28**	**1129.90**	**4641.33**	**1051.34**	**419.29**	**178.34**	**65.25**	**35.02**	**13.33**

CACHUMA RESERVOIR
INFLOW (Acre-feet)
Water Year 1996

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	-21.70	-2.59	-30.30	75.65	344.75	214.40	182.19	53.74	51.86	41.25	17.80	16.10
2	4.90	29.88	16.44	-5.13	187.95	5255.82	175.80	67.27	62.75	14.34	9.00	13.50
3	62.55	10.72	-11.67	42.64	192.72	259.88	157.91	75.98	79.54	26.17	6.40	4.60
4	-19.26	-9.27	8.47	5.88	133.20	316.29	186.15	68.95	51.39	24.10	31.50	-1.70
5	45.48	19.89	-5.21	13.88	114.83	305.70	183.92	32.89	-2.62	54.57	-20.80	-20.10
6	-5.12	-5.43	-2.68	-6.39	238.09	292.62	150.11	67.53	30.08	6.02	-6.40	13.80
7	-6.87	-6.35	28.56	64.15	182.94	299.00	92.61	35.69	42.05	68.88	-5.70	14.80
8	7.93	32.51	24.36	18.64	94.59	264.72	168.95	9.61	62.18	-83.89	-20.50	8.20
9	36.20	-0.18	-3.61	-11.39	114.90	259.02	111.54	29.47	57.50	16.88	32.00	12.30
10	-7.00	18.15	0.68	42.62	58.03	208.58	87.58	76.90	-13.73	16.70	-6.80	-25.90
11	10.99	18.21	-0.49	-2.27	73.89	209.36	90.47	30.25	31.35	36.55	77.30	39.70
12	-5.15	48.94	99.63	38.56	52.44	200.29	125.82	79.49	-17.79	-5.40	19.20	-2.20
13	25.25	-28.40	-57.89	-10.19	80.64	566.56	107.09	64.93	-18.13	29.92	7.00	-23.90
14	3.70	23.15	-33.50	6.84	57.62	745.54	122.25	57.41	9.68	21.05	43.00	-14.50
15	-3.32	26.31	57.27	23.66	54.40	506.20	106.27	31.66	-3.64	12.38	28.20	30.60
16	-2.81	-18.72	-39.21	27.46	86.88	441.63	126.56	77.64	4.86	9.59	25.60	-21.60
17	-2.49	6.44	29.72	22.47	21.52	395.14	54.67	50.30	6.99	9.73	19.70	-12.20
18	17.19	14.10	12.24	23.19	68.44	319.72	33.32	34.60	34.91	9.66	2.00	-4.20
19	26.29	-2.48	0.97	-0.52	33.74	290.34	178.33	-0.58	-24.50	31.80	-27.90	7.70
20	23.98	17.96	5.77	55.58	2310.27	292.78	78.41	28.64	21.21	-7.04	27.80	-23.30
21	42.05	2.06	-14.83	-10.98	5146.40	271.99	85.88	50.14	40.60	51.83	-18.20	1.30
22	-28.73	19.00	100.05	-3.61	2580.69	235.31	121.38	-19.25	-12.82	-2.29	-22.60	-17.00
23	-6.58	13.06	-93.67	22.94	1405.65	160.79	85.31	-3.03	14.67	23.49	21.80	27.10
24	-0.03	20.81	25.84	-29.94	825.64	263.22	103.97	34.94	43.56	-8.43	4.60	4.60
25	-16.80	19.26	-6.53	44.58	535.06	185.10	90.08	11.33	10.96	15.38	-25.90	-24.00
26	-2.36	-5.60	12.59	18.69	500.60	183.54	122.98	64.22	-4.34	12.12	2.10	18.50
27	1.82	19.75	-32.81	18.72	385.20	159.38	91.52	34.59	9.67	50.43	-8.80	-2.10
28	40.33	-18.75	83.07	23.85	469.39	192.73	104.71	22.42	-8.17	-9.79	11.10	3.00
29	4.54	42.25	-47.12	15.61	431.67	154.72	83.56	16.95	-8.69	43.86	28.10	-9.80
30	3.40	22.62	-52.02	57.87		167.79	71.90	-10.46	73.38	42.01	32.00	7.20
31	29.17		68.40	62.63		176.66		19.65		6.29	31.10	
Min	**-28.73**	**-28.40**	**-93.67**	**-29.94**	**21.52**	**154.72**	**33.32**	**-19.25**	**-24.50**	**-83.89**	**-27.90**	**-25.90**
Max	**62.55**	**48.94**	**100.05**	**75.65**	**5146.40**	**5255.82**	**186.15**	**79.49**	**79.54**	**68.88**	**77.30**	**39.70**
Avg	**8.31**	**10.91**	**4.60**	**20.83**	**578.69**	**444.99**	**116.04**	**38.51**	**20.83**	**18.01**	**10.12**	**0.68**

Rainfall to Cachuma Reservoir

CACHUMA RESERVOIR
RAINFALL (Inches)
Water Year 1991

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.00	0.00	0.00	0.00	0.00	2.47	0.05	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.69	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.05	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.58	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.29	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.01	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.19	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.01	0.00
14	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.10	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	3.60	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.03	0.00	0.00	6.10	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.25	0.20	0.00	0.00	1.26	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.23	0.08	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.13	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	1.30	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	3.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00		0.00	0.00		0.00		0.00		0.00	0.00	
Min	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max	**0.00**	**0.25**	**0.20**	**0.58**	**3.09**	**6.10**	**0.08**	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**
Avg	**0.00**	**0.01**	**0.02**	**0.04**	**0.12**	**0.60**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

CACHUMA RESERVOIR
RAINFALL (Inches)
Water Year 1992

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.10	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.24	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	1.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.63	0.83	1.29	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.19	0.25	0.20	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.19	0.23	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.07	0.00	0.00
10	0.00	0.00	0.00	0.00	2.78	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	2.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	4.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	2.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.00	1.41	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.48	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	2.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	2.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	1.52	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00		0.00	0.00		0.41		0.00		0.00	0.00	
Min	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max	**0.48**	**0.10**	**2.54**	**1.61**	**4.70**	**1.41**	**0.06**	**0.00**	**0.00**	**0.07**	**0.00**	**0.00**
Avg	**0.02**	**0.00**	**0.21**	**0.10**	**0.48**	**0.17**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

CACHUMA RESERVOIR
RAINFALL (Inches)
Water Year 1993

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.03	0.00	0.03	0.00	0.00	0.00	0.41	0.00	0.00	0.00
6	0.00	0.00	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	2.10	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.27	0.42	2.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.10	1.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.03	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.29	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	3.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	1.85	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	1.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.17	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.12	2.52	0.76	0.03	0.02	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.07	3.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	1.34	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.00	1.32	3.36	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.06	0.26	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.03	1.03	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	1.94	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.46	0.00	0.35	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.33		0.00	0.10		0.00		0.00		0.00	0.00	
Min	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max	**0.46**	**0.00**	**2.10**	**3.00**	**3.16**	**3.36**	**0.02**	**0.00**	**0.41**	**0.00**	**0.00**	**0.00**
Avg	**0.03**	**0.00**	**0.18**	**0.38**	**0.43**	**0.20**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**

CACHUMA RESERVOIR
RAINFALL (Inches)
Water Year 1994

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	1.70	0.18	0.00	0.01	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	1.13	0.00	0.00	0.36	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.26	0.40	0.11	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	1.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.00	1.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.32	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.18	0.23	0.00	0.18	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	1.91	0.38	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
24	0.00	0.00	0.00	0.17	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	1.03	0.00	1.64	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.05	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.02
30	0.00	0.62	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00		0.00	0.00		0.00		0.00		0.00	0.00	
Min	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max	**0.26**	**0.62**	**1.55**	**1.03**	**1.91**	**1.64**	**0.34**	**0.36**	**0.00**	**0.00**	**0.00**	**0.04**
Avg	**0.01**	**0.04**	**0.07**	**0.05**	**0.27**	**0.09**	**0.03**	**0.03**	**0.00**	**0.00**	**0.00**	**0.00**

CACHUMA RESERVOIR
RAINFALL (Inches)
Water Year 1995

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.02	0.05	0.00	0.00	0.00
3	0.00	0.00	0.00	1.48	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00
4	0.38	0.00	0.03	1.04	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00
5	0.65	0.00	0.00	2.83	0.00	0.95	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.09	0.00	1.33	0.00	0.03	0.00	0.00	0.00	0.00
7	0.00	0.00	0.08	1.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.14	0.00	0.09	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	1.58	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.89	0.00	6.25	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	1.02	0.00	4.95	0.00	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.35	0.00	1.12	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
14	0.00	0.00	0.01	0.00	1.49	0.00	0.00	0.19	0.00	0.00	0.00	0.00
15	0.00	0.00	0.05	0.22	0.00	0.00	0.00	0.75	0.00	0.00	0.00	0.00
16	0.00	0.13	0.00	0.30	0.00	0.00	0.36	0.77	0.16	0.00	0.00	0.00
17	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.00
18	0.00	0.02	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.71	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.83	0.00	2.53	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.00	2.98	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.65	3.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.21	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.05	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.03	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00		0.00	0.00		0.00		0.00		0.00	0.00	
Min	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max	**0.65**	**0.89**	**0.65**	**6.25**	**1.49**	**4.95**	**0.36**	**0.77**	**0.27**	**0.00**	**0.00**	**0.00**
Avg	**0.03**	**0.05**	**0.03**	**0.81**	**0.07**	**0.40**	**0.02**	**0.06**	**0.02**	**0.00**	**0.00**	**0.00**

CACHUMA RESERVOIR
RAINFALL (Inches)
Water Year 1996

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.00	0.25	0.00	0.00	1.19	0.01	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.70	0.00	0.01	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.53	0.16	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.12	0.20	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.37	0.03	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
12	0.00	0.00	0.06	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.56	0.00	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.08	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00
15	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.00	0.01	0.00	0.00	0.11	0.00	0.00	0.15	0.00	0.00	0.00	0.00
17	0.00	0.00	0.00	0.49	0.00	0.00	0.11	0.04	0.00	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.25	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	2.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.00	0.00	0.00	0.09	0.93	0.03	0.00	0.00	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.25	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.05	0.30	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.01	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	0.00	0.00	0.00	0.17	0.26	0.08	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00		0.00	0.60		0.00		0.00		0.00	0.00	
Min	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max	**0.00**	**0.25**	**0.57**	**0.60**	**2.03**	**0.81**	**0.26**	**0.15**	**0.00**	**0.02**	**0.00**	**0.00**
Avg	**0.00**	**0.01**	**0.04**	**0.07**	**0.24**	**0.06**	**0.02**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**

Spill from Cachuma Reservoir

CACHUMA RESERVOIR
SPILL (Acre-feet)
Water Year 1991

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0		0	0	0	0	0	0	0
30	0	0	0	0		0	0	0	0	0	0	0
31	0		0	0		0		0		0	0	
Min	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Max	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Avg	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

CACHUMA RESERVOIR
SPILL (Acre-feet)
Water Year 1992

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0		0	0	0	0	0	0	0
30	0	0	0	0		0	0	0	0	0	0	0
31	0		0	0		0		0		0	0	
Min	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Max	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Avg	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

CACHUMA RESERVOIR
SPILL (Acre-feet)
Water Year 1993

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0	0	0	0	684	3979	2509	326	84	0	0	0
2	0	0	0	0	684	3508	2000	307	72	0	0	0
3	0	0	0	0	684	3004	1792	334	56	0	0	0
4	0	0	0	0	684	2942	1696	303	31	0	0	0
5	0	0	0	0	621	2460	1618	309	29	0	0	0
6	0	0	0	0	602	2254	1435	306	44	0	0	0
7	0	0	0	0	605	2347	1339	274	47	0	0	0
8	0	0	0	0	1898	1842	1339	254	28	0	0	0
9	0	0	0	0	14122	1978	1224	167	34	0	0	0
10	0	0	0	0	5010	1608	1099	149	29	0	0	0
11	0	0	0	0	3048	1378	1002	209	20	0	0	0
12	0	0	0	0	2127	1305	1002	213	20	0	0	0
13	0	0	0	0	2155	1241	921	214	20	0	0	0
14	0	0	0	0	1843	1008	863	150	20	0	0	0
15	0	0	0	0	1382	985	799	215	20	0	0	0
16	0	0	0	1246	1294	982	704	250	20	0	0	0
17	0	0	0	5318	1410	982	645	245	20	0	0	0
18	0	0	0	9120	1251	982	645	246	20	0	0	0
19	0	0	0	10158	9707	982	703	187	12	0	0	0
20	0	0	0	4816	14176	971	668	177	9	0	0	0
21	0	0	0	2648	8029	920	644	135	10	0	0	0
22	0	0	0	2225	5365	761	552	82	10	0	0	0
23	0	0	0	1866	6054	518	446	82	20	0	0	0
24	0	0	0	1601	15582	526	446	79	20	0	0	0
25	0	0	0	1116	7620	630	427	122	20	0	0	0
26	0	0	0	1007	5783	13459	427	144	0	0	0	0
27	0	0	0	1181	5864	8090	427	164	0	0	0	0
28	0	0	0	741	4579	4989	427	145	0	0	0	0
29	0	0	0	738		3918	427	114	0	0	0	0
30	0	0	0	804		3263	380	88	0	0	0	0
31	0		0	889		2508		82		0	0	
Min	**0**	**0**	**0**	**0**	**602**	**518**	**380**	**79**	**0**	**0**	**0**	**0**
Max	**0**	**0**	**0**	**10158**	**15582**	**13459**	**2509**	**334**	**84**	**0**	**0**	**0**
Avg	**0**	**0**	**0**	**1467**	**4388**	**2462**	**954**	**196**	**24**	**0**	**0**	**0**

CACHUMA RESERVOIR
SPILL (Acre-feet)
Water Year 1994

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0		0	0	0	0	0	0	0
30	0	0	0	0		0	0	0	0	0	0	0
31	0		0	0		0		0		0	0	
Min	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Max	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Avg	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

CACHUMA RESERVOIR
SPILL (Acre-feet)
Water Year 1995

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0	0	0	0	4540.40	610.40	1977.40	439.40	78.40	120.40	0	0
2	0	0	0	0	3246.40	561.40	1747.40	439.40	62.40	118.40	0	0
3	0	0	0	0	2931.40	735.40	1769.40	403.40	61.40	123.40	0	0
4	0	0	0	0	2314.40	767.40	1601.40	366.40	61.40	113.40	0	0
5	0	0	0	0	2269.40	857.40	1437.40	366.40	65.40	100.40	0	0
6	0	0	0	0	2078.40	3591.40	1420.40	366.40	64.40	75.40	0	0
7	0	0	0	0	1980.40	4559.40	1352.40	304.40	59.40	16.40	0	0
8	0	0	0	0	2058.40	4943.40	1256.40	304.40	63.40	16.40	0	0
9	0	0	0	0	2156.40	3395.40	1083.40	304.40	63.40	0	0	0
10	0	0	0	835.40	2252.40	1476.40	972.40	306.40	67.40	0	0	0
11	0	0	0	3730.90	2095.40	6880.40	1129.40	294.40	63.40	0	0	0
12	0	0	0	6356.90	1703.40	9918.40	1073.40	302.40	61.40	0	0	0
13	0	0	0	6240.00	1954.40	9789.40	959.40	307.40	61.40	0	0	0
14	0	0	0	5069.00	1762.40	9187.40	328.40	240.40	63.40	0	0	0
15	0	0	0	3991.40	2044.40	9572.40	766.40	260.40	59.40	0	0	0
16	0	0	0	3976.40	2059.40	8678.40	991.40	389.40	111.40	0	0	0
17	0	0	0	3461.40	2058.40	8282.40	984.40	293.40	120.40	0	0	0
18	0	0	0	3268.40	2016.40	6722.40	775.40	312.40	119.40	0	0	0
19	0	0	0	2984.40	2008.40	4976.40	841.40	282.40	120.40	0	0	0
20	0	0	0	2692.40	1592.40	3835.40	696.40	308.40	120.40	0	0	0
21	0	0	0	2150.40	1023.40	2772.40	656.40	297.40	120.40	0	0	0
22	0	0	0	2998.40	851.40	2939.40	616.40	296.40	120.40	0	0	0
23	0	0	0	2690.40	607.40	5010.40	616.40	241.40	119.40	0	0	0
24	0	0	0	4555.40	550.40	10755.40	595.40	192.40	121.40	0	0	0
25	0	0	0	6264.90	535.40	6540.40	707.40	208.40	120.40	0	0	0
26	0	0	0	13110.90	536.40	3951.40	424.40	248.40	123.40	0	0	0
27	0	0	0	12123.00	537.40	3165.40	397.40	295.40	120.40	0	0	0
28	0	0	0	8886.40	587.40	2889.40	471.40	302.40	122.40	0	0	0
29	0	0	0	7991.40		2663.40	403.40	296.40	119.40	0	0	0
30	0	0	0	7658.40		2251.40	439.40	279.40	122.40	0	0	0
31	0		0	7231.40		2174.40		144.40		0	0	
Min	**0**	**0**	**0**	**0**	**535**	**561**	**328**	**144**	**59**	**0**	**0**	**0**
Max	**0**	**0**	**0**	**13111**	**4540**	**10755**	**1977**	**439**	**123**	**123**	**0**	**0**
Avg	**0**	**0**	**0**	**3815**	**1798**	**4660**	**950**	**303**	**92**	**22**	**0**	**0**

CACHUMA RESERVOIR
SPILL (Acre-feet)
Water Year 1996

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0		0	0	0	0	0	0	0
31	0		0	0		0		0		0	0	
Min	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Max	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Avg	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Controlled Releases

CACHUMA RESERVOIR
CONTROLLED RELEASE (Acre-feet)
Water Year 1991

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	107.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	106.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	112.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	110.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	132.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	155.3	103.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	177.8	123.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	222.6	137.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	211.3	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	216.6	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	197.4	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	201.7	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	187.5	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	232.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	194.4	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	188.6	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	142.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	132.3	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	143.1	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	130.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	131.3	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	144.6	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	150.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	91.5	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	107.8	0.0	0.0	76.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	108.6	0.0	0.0	30.0
29	0.0	0.0	0.0	0.0		0.0	0.0	0.0	114.7	0.0	0.0	16.0
30	0.0	0.0	0.0	0.0		0.0	0.0	0.0	92.1	0.0	0.0	4.0
31	0.0		0.0	0.0		0.0		0.0		0.0	0.0	0.0
Min	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Max	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**232.0**	**137.0**	**0.0**	**76.0**
Avg	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**127.2**	**33.5**	**0.0**	**4.1**

CACHUMA RESERVOIR
CONTROLLED RELEASE (Acre-feet)
Water Year 1992

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	259.0
2	242.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	138.0
3	253.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	202.0	0.0	147.0
4	248.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	198.0	0.0	148.0
5	260.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	108.0	0.0	149.0
6	246.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	102.0	0.0	148.0
7	260.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	139.0	0.0	145.0
8	262.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	149.0	0.0	151.0
9	283.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	23.0	0.0	147.0
10	290.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	156.0
11	292.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	140.0
12	286.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	104.0
13	287.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	99.0
14	290.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	97.0
15	277.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0
16	280.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	280.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	280.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	286.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	202.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	187.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	262.0	0.0
22	203.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	257.0	0.0
23	198.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	257.0	198.0
24	98.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	259.0	123.0
25	98.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	253.0	77.0
26	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	284.0	79.0
27	103.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	273.0	83.0
28	94.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	261.0	73.0
29	98.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	268.0	79.0
30	97.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	261.0	79.0
31	16.0		0.0	0.0		0.0		0.0		0.0	265.0	
Min	**4.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Max	**292.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**202.0**	**284.0**	**259.0**
Avg	**206.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**29.7**	**93.5**	**96.0**

CACHUMA RESERVOIR
CONTROLLED RELEASE (Acre-feet)
Water Year 1993

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	80.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	80.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	79.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	80.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	79.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	79.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	80.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	81.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	76.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	79.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	81.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	78.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	81.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	76.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	76.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	21.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0		0.0	0.0		0.0		0.0		0.0	0.0	
Min	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Max	**81.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Avg	**49.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

CACHUMA RESERVOIR
CONTROLLED RELEASE (Acre-feet)
Water Year 1994

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	275.0	115.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	270.0	120.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	274.0	94.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	272.0	98.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	269.0	96.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	275.0	96.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	163.0	97.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	139.0	97.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	138.0	96.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.0	93.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.0	109.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	95.0	93.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	97.0	100.0
14	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	96.0	99.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96.0	98.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	138.0	103.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	139.0	100.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	142.0	97.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	131.0	99.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	143.0	93.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.0	67.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	132.0	59.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.0	55.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	137.0	56.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	148.0	57.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	280.0	130.0	56.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	289.0	151.0	56.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	272.0	127.0	60.0
29	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	269.0	133.0	55.0
30	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	284.0	121.0	58.0
31	0.0		0.0	0.0		0.0		0.0		261.0	120.0	
Min	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**95.0**	**55.0**
Max	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.0**	**0.0**	**0.0**	**289.0**	**275.0**	**120.0**
Avg	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**53.4**	**155.4**	**85.7**

CACHUMA RESERVOIR
CONTROLLED RELEASE (Acre-feet)
Water Year 1995

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	55.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	64.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	53.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	60.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	37.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	38.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	38.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	135.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	139.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	102.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	98.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	96.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	98.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	98.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
18	47.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	40.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	38.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	34.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	30.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
23	23.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24	18.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	15.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	19.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	10.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	7.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	6.0		0.0	0.0		0.0		0.0		0.0	0.0	
Min	**6.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Max	**139.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Avg	**49.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

CACHUMA RESERVOIR
CONTROLLED RELEASE (Acre-feet)
Water Year 1996

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	137.0	57.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	133.0	60.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	137.0	60.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	136.0	58.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	129.0	60.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	136.0	59.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	134.0	59.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	132.0	58.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	137.0	58.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	134.0	142.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	137.0	116.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	134.0	99.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	134.0	96.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	134.0	100.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	136.0	98.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.0	94.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.0	99.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	94.0	83.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	245.0	98.0	80.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	271.0	98.0	81.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	273.0	97.0	78.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	269.0	99.0	79.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	270.0	98.0	74.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	270.0	97.0	76.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	273.0	141.0	99.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	271.0	142.0	99.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	273.0	140.0	99.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	268.0	107.0	99.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	264.0	71.0	86.0
30	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	143.0	59.0	77.0
31	0.0		0.0	0.0		0.0		0.0		132.0	61.0	
Min	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**59.0**	**57.0**
Max	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**273.0**	**142.0**	**142.0**
Avg	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**103.9**	**116.4**	**82.8**

Fish Reserve Account Releases

CACHUMA RESERVOIR
FISH RESERVE ACCOUNT RELEASES (Acre-feet)
Water Year 1991

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
Min	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Max	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Avg	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR

CACHUMA RESERVOIR
FISH RESERVE ACCOUNT RELEASES (Acre-feet)
Water Year 1992

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
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21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
Min	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Max	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
Avg	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR

CACHUMA RESERVOIR
FISH RESERVE ACCOUNT RELEASES (Acre-feet)
Water Year 1993

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	15.0	18.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.0	18.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	15.0	18.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	16.0	19.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.0	18.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	15.0	19.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.0	18.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.0	19.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	15.0	18.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.0	18.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.0	20.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	16.0	18.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.0	18.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	17.0	18.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.0	19.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	16.0	17.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.0	15.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	16.0	13.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13.0	17.0	12.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	17.0	13.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	18.0	12.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	16.0	13.0
23	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.0	17.0	12.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	16.0	13.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.0	17.0	13.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	16.0	16.0	12.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	16.0	17.0	12.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	16.0	18.0	9.0
29	0.0	0.0	0.0	0.0		0.0	0.0	0.0	10.0	16.0	17.0	9.0
30	0.0	0.0	0.0	0.0		0.0	0.0	0.0	10.0	17.0	18.0	8.0
31	0.0		0.0	0.0		0.0		0.0		17.0	19.0	
Min	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**13.0**	**15.0**	**8.0**
Max	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**10.0**	**17.0**	**19.0**	**20.0**
Avg	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**1.7**	**14.7**	**16.7**	**15.3**

CACHUMA RESERVOIR
FISH RESERVE ACCOUNT RELEASES (Acre-feet)
Water Year 1994

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	9.0	5.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0	0.0
2	9.0	4.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	19.0	0.0	0.0
3	8.0	3.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0
4	9.0	2.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	8.0	0.0	0.0
5	8.0	1.0	0.4	0.0	4.0	0.0	0.0	0.0	0.0	6.0	0.0	0.0
6	9.0	3.0	0.8	0.0	3.7	0.0	0.0	0.0	0.0	4.0	0.0	0.0
7	9.0	3.0	0.8	0.0	2.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
8	8.0	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	9.0	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	9.0	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	8.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
12	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
13	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
14	9.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.0	0.0	0.0
15	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
16	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	3.0	0.0	0.0
17	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	3.0	0.0	0.0
18	9.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	3.0	0.0	0.0
19	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	3.0	0.0	0.0
20	9.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	3.0	0.0	0.0
21	9.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0	0.0	0.0
22	8.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	3.0	0.0	0.0
23	10.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.7	0.0	0.0
24	10.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0
25	9.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	0.0	0.0
26	9.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0	0.0
27	9.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0
28	10.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.0	0.0
29	8.0	1.0	0.0	0.0		0.0	0.0	0.0	20.0	0.0	0.0	0.0
30	8.0	1.0	0.0	0.0		0.0	0.0	0.0	20.0	0.0	0.0	0.0
31	6.0		0.0	0.0		0.0		0.0		0.0	0.0	
Min	**6.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Max	**10.0**	**5.0**	**0.8**	**0.0**	**4.0**	**0.0**	**1.0**	**0.0**	**20.0**	**20.0**	**0.0**	**0.0**
Avg	**8.7**	**1.2**	**0.2**	**0.0**	**0.3**	**0.0**	**0.0**	**0.0**	**1.8**	**3.2**	**0.0**	**0.0**

CACHUMA RESERVOIR
FISH RESERVE ACCOUNT RELEASES (Acre-feet)
Water Year 1995

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	10.0
2	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	10.0	10.0
3	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	10.0	9.0
4	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	9.0	10.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	10.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	7.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	12.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	10.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	10.0	10.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	9.0	10.0
11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	11.0	10.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	9.0	9.0
13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	10.0	10.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	10.0	10.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	10.0	10.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	10.0	9.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	9.0	10.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	10.0	10.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	10.0	10.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	10.0	10.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	10.0	9.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	9.0	9.0
23	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	5.0	11.0	10.0
24	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	9.0	10.0
25	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	9.0	10.0
26	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	10.0	10.0
27	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0	10.0	9.0
28	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0	9.0	10.0
29	0.0	0.0	0.0	0.0		0.0	0.0	0.0	0.0	10.0	10.0	10.0
30	0.0	0.0	1.0	0.0		0.0	0.0	0.0	0.0	10.0	10.0	10.0
31	0.0		1.0	0.0		0.0		0.0		9.0	9.0	9.0
Min	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**9.0**	**7.0**
Max	**0.0**	**0.0**	**1.0**	**1.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**16.0**	**11.0**	**12.0**
Avg	**0.0**	**0.0**	**0.3**	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**5.2**	**9.7**	**9.7**

CACHUMA RESERVOIR
FISH RESERVE ACCOUNT RELEASES (Acre-feet)
Water Year 1996

Day	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept
1	10.0	10.0	10.0	6.0	6.0	6.0	6.0	5.0	5.0	6.0	0.0	0.0
2	10.0	11.0	9.0	6.0	6.0	5.0	6.0	6.0	6.0	5.0	0.0	0.0
3	9.0	10.0	10.0	6.0	6.0	6.0	7.0	6.0	5.0	6.0	0.0	0.0
4	10.0	9.0	10.0	7.0	6.0	6.0	5.0	7.0	6.0	5.0	0.0	0.0
5	10.0	10.0	10.0	6.0	6.0	6.0	6.0	5.0	6.0	5.0	0.0	0.0
6	10.0	11.0	10.0	6.0	5.0	5.0	6.0	6.0	6.0	6.0	0.0	0.0
7	10.0	10.0	10.0	5.0	7.0	6.0	6.0	6.0	6.0	5.0	0.0	0.0
8	9.0	9.0	10.0	6.0	6.0	6.0	6.0	6.0	7.0	5.0	0.0	0.0
9	10.0	10.0	9.0	6.0	6.0	6.0	7.0	6.0	6.0	6.0	0.0	0.0
10	10.0	10.0	11.0	6.0	5.0	6.0	5.0	6.0	5.0	4.0	0.0	0.0
11	10.0	10.0	9.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	0.0	0.0
12	10.0	10.0	10.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	0.0	0.0
13	10.0	10.0	10.0	6.0	6.0	6.0	6.0	6.0	5.0	5.0	0.0	0.0
14	10.0	10.0	10.0	6.0	6.0	5.0	6.0	6.0	6.0	6.0	0.0	0.0
15	9.0	10.0	6.0	5.0	6.0	7.0	6.0	6.0	6.0	5.0	0.0	0.0
16	10.0	10.0	6.0	7.0	6.0	6.0	6.0	6.0	5.0	5.0	0.0	0.0
17	10.0	10.0	6.0	5.0	6.0	6.0	6.0	6.0	5.0	5.0	0.0	0.0
18	9.0	10.0	6.0	7.0	6.0	6.0	6.0	5.0	5.0	6.0	0.0	0.0
19	10.0	10.0	6.0	5.0	6.0	6.0	6.0	5.0	6.0	0.0	0.0	0.0
20	11.0	10.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	0.0	0.0	0.0
21	10.0	9.0	6.0	7.0	5.0	6.0	6.0	5.0	6.0	0.0	0.0	0.0
22	10.0	10.0	7.0	5.0	7.0	6.0	6.0	6.0	6.0	0.0	0.0	0.0
23	10.0	10.0	6.0	6.0	5.0	6.0	6.0	4.0	6.0	0.0	0.0	0.0
24	9.0	10.0	6.0	6.0	6.0	6.0	5.0	5.0	5.0	0.0	0.0	0.0
25	10.0	10.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	0.0	0.0	0.0
26	10.0	10.0	7.0	6.0	6.0	6.0	6.0	6.0	6.0	0.0	0.0	0.0
27	10.0	10.0	6.0	6.0	6.0	6.0	6.0	6.0	5.0	0.0	0.0	0.0
28	10.0	10.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	0.0	0.0	0.0
29	10.0	10.0	7.0	5.0	6.0	6.0	6.0	6.0	5.0	0.0	0.0	0.0
30	10.0	10.0	6.0	6.0		5.0	7.0	6.0	6.0	0.0	0.0	0.0
31	9.0		7.0	6.0		6.0		6.0		0.0	0.0	
Min	**9.0**	**9.0**	**5.0**	**5.0**	**5.0**	**5.0**	**5.0**	**4.0**	**5.0**	**0.0**	**0.0**	**0.0**
Max	**11.0**	**11.0**	**11.0**	**7.0**	**7.0**	**7.0**	**7.0**	**7.0**	**7.0**	**6.0**	**0.0**	**0.0**
Avg	**9.8**	**10.0**	**7.8**	**5.9**	**5.9**	**5.9**	**6.0**	**5.8**	**5.7**	**3.1**	**0.0**	**0.0**

Santa Ynez River Flow Near Santa Ynez
(May 1994 - September 1996)

SANTA YNEZ RIVER NEAR SANTA YNEZ, CALIF.
1994 Water Year
USGS gage #11126000

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	---	---	---	---	---	---	---	0	0	0	135	43
DAY_02	---	---	---	---	---	---	---	0	0	0	136	34
DAY_03	---	---	---	---	---	---	---	0	0	0	142	28
DAY_04	---	---	---	---	---	---	---	0	0	0	151	28
DAY_05	---	---	---	---	---	---	---	0	0	0	118	33
DAY_06	---	---	---	---	---	---	---	0	0	0	48	33
DAY_07	---	---	---	---	---	---	---	0	0	0	60	38
DAY_08	---	---	---	---	---	---	---	0	0	0	72	41
DAY_09	---	---	---	---	---	---	---	0	0	0	49	42
DAY_10	---	---	---	---	---	---	---	0	0	0	33	45
DAY_11	---	---	---	---	---	---	---	0	0	0	32	47
DAY_12	---	---	---	---	---	---	---	0	0	0	31	48
DAY_13	---	---	---	---	---	---	---	0	0	0.03	31	49
DAY_14	---	---	---	---	---	---	---	0	0	0.02	30	50
DAY_15	---	---	---	---	---	---	---	0	0	0.01	50	50
DAY_16	---	---	---	---	---	---	---	0	0	0	66	51
DAY_17	---	---	---	---	---	---	---	0	0	0	66	51
DAY_18	---	---	---	---	---	---	---	0	0	0	65	52
DAY_19	---	---	---	---	---	---	---	0	0	0	63	51
DAY_20	---	---	---	---	---	---	---	0	0	0	63	40
DAY_21	---	---	---	---	---	---	---	0	0	0	63	18
DAY_22	---	---	---	---	---	---	---	0	0	0	63	19
DAY_23	---	---	---	---	---	---	---	0	0	0	60	25
DAY_24	---	---	---	---	---	---	---	0	0	0	59	27
DAY_25	---	---	---	---	---	---	---	0	0	70	58	28
DAY_26	---	---	---	---	---	---	---	0	0	135	57	29
DAY_27	---	---	---	---	---	---	---	0	0	135	56	31
DAY_28	---	---	---	---	---	---	---	0	0	135	56	31
DAY_29	---	---	---	---	---	---	---	0	0	135	45	26
DAY_30	---	---	---	---	---	---	0	0	0	135	40	29
DAY_31	---	---	---	---	---	---	---	0	---	135	40	---
MONTH_TOT	---	---	---	---	---	---	---	0.00	0.00	880.06	2038.00	1117.00
MONTH_MEAN	---	---	---	---	---	---	---	0.00	0.00	28.39	65.74	37.23
MONTH_MAX	---	---	---	---	---	---	---	0.00	0.00	135.00	151.00	52.00
MONTH_MIN	---	---	---	---	---	---	---	0.00	0.00	0.00	30.00	18.00

Source: published data from USGS

SANTA YNEZ RIVER NEAR SANTA YNEZ, CALIF.
1995 Water Year
USGS gage #11126000

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	---	---	---	---	---	---	---	---	13	78	8.5	---
DAY_02	---	---	---	---	---	---	---	---	12	82	8.6	---
DAY_03	---	---	---	---	---	---	---	---	13	83	---	---
DAY_04	---	---	---	---	---	---	---	---	14	76	---	---
DAY_05	---	---	---	---	---	---	---	---	13	57	---	---
DAY_06	---	---	---	---	---	---	---	---	14	22	---	---
DAY_07	---	---	---	---	---	---	---	---	15	3.5	---	---
DAY_08	---	---	---	---	---	---	---	---	15	3.2	---	---
DAY_09	---	---	---	---	---	---	---	---	17	2.7	---	---
DAY_10	---	---	---	---	---	---	---	---	16	1.4	---	---
DAY_11	---	---	---	---	---	---	---	---	15	0.74	---	---
DAY_12	---	---	---	---	---	---	---	---	15	1.1	---	---
DAY_13	---	---	---	---	---	---	---	---	15	1.8	---	---
DAY_14	---	---	---	---	---	---	---	---	17	1.8	---	---
DAY_15	---	---	---	---	---	---	---	---	37	2.1	---	---
DAY_16	---	---	---	---	---	---	---	---	62	2.7	---	---
DAY_17	---	---	---	---	---	---	---	---	63	3.3	---	---
DAY_18	---	---	---	---	---	---	---	---	62	3.4	---	---
DAY_19	---	---	---	---	---	---	---	---	63	4	---	---
DAY_20	---	---	---	---	---	---	---	---	61	4.6	---	---
DAY_21	---	---	---	---	---	---	---	---	64	8.9	---	---
DAY_22	---	---	---	---	---	---	---	---	68	7.4	---	---
DAY_23	---	---	---	---	---	---	---	101	69	7.1	---	---
DAY_24	---	---	---	---	---	---	---	98	72	7.7	---	---
DAY_25	---	---	---	---	---	---	---	105	75	11	---	---
DAY_26	---	---	---	---	---	---	---	156	76	13	---	---
DAY_27	---	---	---	---	---	---	---	158	75	8.5	---	---
DAY_28	---	---	---	---	---	---	---	160	77	8.9	---	---
DAY_29	---	---	---	---	---	---	---	155	77	8.8	---	---
DAY_30	---	---	---	---	---	---	---	82	79	8.5	---	---
DAY_31	---		---	---	---	---	---	25	---	8.2	---	---
MONTH_TOT	---	---	---	---	---	---	---	---	1284.00	532.34	---	---
MONTH_MEAN	---	---	---	---	---	---	---	---	42.80	17.17	---	---
MONTH_MAX	---	---	---	---	---	---	---	---	79.00	83.00	---	---
MONTH_MIN	---	---	---	---	---	---	---	---	12.00	0.74	---	---

Source: unpublished data from USGS

SANTA YNEZ RIVER NEAR SANTA YNEZ, CALIF.
1996 Water Year
USGS gage #11126000

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	24	---	---	6.7	14	12	9.9	0	---	---	---	---
DAY_02	26	---	---	6.4	15	13	10	1.2	---	---	---	---
DAY_03	27	---	---	6.3	18	14	10	2.6	---	---	---	---
DAY_04	23	---	---	5.9	12	15	9.6	2.5	---	---	---	---
DAY_05	16	---	---	5.3	12	14	---	1.8	---	---	---	---
DAY_06	18	---	---	4.8	11	14	10	1.7	---	---	---	---
DAY_07	20	---	---	4.6	11	13	9.8	2.5	---	---	---	---
DAY_08	21	---	---	4.5	9.6	14	11	2	---	---	---	---
DAY_09	23	---	---	4.1	9.3	14	11	2.2	---	---	---	---
DAY_10	43	---	---	4.1	8	16	10	2.4	---	---	---	---
DAY_11	74	---	---	3.8	8.3	15	9.9	2.7	---	---	---	---
DAY_12	81	---	---	5.2	9.5	18	10	3.3	---	---	---	---
DAY_13	---	---	---	5.9	9	22	11	3.1	---	---	---	---
DAY_14	---	---	---	4.8	9.3	20	11	3	---	---	---	---
DAY_15	---	---	---	5.1	9.9	18	12	3.1	---	---	---	---
DAY_16	---	---	---	6.2	10	15	12	3.9	---	---	---	---
DAY_17	---	---	---	6	10	15	0.05	4.8	---	---	---	---
DAY_18	---	---	---	6.6	9.9	14	0	5.4	---	---	---	---
DAY_19	---	---	---	6.8	12	13	0	6.3	---	---	---	---
DAY_20	---	---	---	6.8	51	11	0	5.6	---	---	---	---
DAY_21	---	---	---	7.1	30	10	0	4.6	---	---	---	---
DAY_22	---	---	---	7.1	22	9.3	0	3.9	---	---	---	---
DAY_23	---	---	---	7.3	15	9.2	0	2.5	---	---	---	---
DAY_24	---	---	---	8.6	12	8.4	0	2.2	---	---	---	---
DAY_25	---	---	---	10	11	7	0	4.4	---	---	---	---
DAY_26	---	---	---	11	12	4.7	0	6.6	---	---	---	---
DAY_27	---	---	---	11	13	1.2	0	7.2	---	---	---	---
DAY_28	---	---	---	10	12	3.7	0	7	---	---	---	---
DAY_29	---	---	---	10	12	8.2	0	6.4	---	---	---	---
DAY_30	---	---	6.8	12	---	9.1	0	---	---	---	---	---
DAY_31	---	---	6.5	18	---	8.6	---	---	---	---	---	---
MONTH_TOT	---	---	---	222.00	397.80	379.40	---	---	---	---	---	---
MONTH_MEAN	---	---	---	7.16	13.72	12.24	---	---	---	---	---	---
MONTH_MAX	---	---	---	18.00	51.00	22.00	---	---	---	---	---	---
MONTH_MIN	---	---	---	3.80	8.00	1.20	---	---	---	---	---	---

Source: provisional data from USGS

Santa Ynez River Flow Near Solvang

SANTA YNEZ RIVER AT SOLVANG, CALIF.
1991 Water Year (cfs)
USGS gage #11128500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0	0	0	0	0	0	20	0.06	0	46	0	0
DAY_02	0	0	0	0	0	0	26	0	0	48	0	0
DAY_03	0	0	0	0	0	0	13	0.05	0	46	0	0
DAY_04	0	0	0	0	0	0	27	0.32	0	46	0	0
DAY_05	0	0	0	0	0	0	20	0.7	0	49	0	0
DAY_06	0	0	0	0	0	0	20	0.58	0	58	0	0
DAY_07	0	0	0	0	0	0	15	0.4	0	53	0	0
DAY_08	0	0	0	0	0	0	13	0.09	0	57	0	0
DAY_09	0	0	0	0	0	0	8.9	0	0	58	0	0
DAY_10	0	0	0	0	0	0	9.2	0	39	33	0	0
DAY_11	0	0	0	0	0	0	7.3	0	60	8	0	0
DAY_12	0	0	0	0	0	0	5.2	0	61	1.5	0	0
DAY_13	0	0	0	0	0	0	4	0	60	0.47	0	0
DAY_14	0	0	0	0	0	0	3.7	0	61	0.27	0	0
DAY_15	0	0	0	0	0	0	3.5	0	64	0.19	0	0
DAY_16	0	0	0	0	0	0	2.4	0	63	0.05	0	0
DAY_17	0	0	0	0	0	0	1.9	0	62	0	0	0
DAY_18	0	0	0	0	0	590	1.6	0	59	0	0	0
DAY_19	0	0	0	0	0	1860	1	0	57	0	0	0
DAY_20	0	0	0	0	0	892	0.81	0	57	0	0	0
DAY_21	0	0	0	0	0	106	0.8	0	59	0	0	0
DAY_22	0	0	0	0	0	49	0.81	0	60	0	0	0
DAY_23	0	0	0	0	0	21	0.81	0	60	0	0	0
DAY_24	0	0	0	0	0	31	0.54	0	60	0	0	0
DAY_25	0	0	0	0	0	152	0.42	0	59	0	0	0
DAY_26	0	0	0	0	0	220	0.44	0	43	0	0	0
DAY_27	0	0	0	0	0	367	0.61	0	40	0	0	0
DAY_28	0	0	0	0	0	41	0.65	0	41	0	0	0
DAY_29	0	0	0	0	---	7.1	0.64	0	43	0	0	0
DAY_30	0	0	0	0	---	7.6	0.28	0	42	0	0	0
DAY_31	0	---	0	0	---	22	---	0	---	0	0	---
MONTH_TOT	0.00	0.00	0.00	0.00	0.00	4365.70	209.51	2.20	1150.00	504.48	0.00	0.00
MONTH_MEAN	0.00	0.00	0.00	0.00	0.00	140.83	6.98	0.07	38.33	16.27	0.00	0.00
MONTH_MAX	0.00	0.00	0.00	0.00	0.00	1860.00	27.00	0.70	64.00	58.00	0.00	0.00
MONTH_MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00

Source: published data from USGS

SANTA YNEZ RIVER AT SOLVANG, CALIF.
1992 Water Year (cfs)
USGS gage #11128500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0	21	0	8.2	2.4	25	13	0	0	0	0	99
DAY_02	0	17	0	4.6	2.4	36	14	0	0	0	0	58
DAY_03	0	14	0	3.7	2.4	27	16	0	0	0	0	61
DAY_04	0	12	0	2.8	1.5	24	17	0	0	0	0	60
DAY_05	0.38	10	0	200	1	34	19	0	0	0	0	61
DAY_06	35	8.5	0	38	0.73	166	22	0	0	0	0	59
DAY_07	71	3.3	0	25	0.36	86	24	0	0	0	0	63
DAY_08	96	0.16	0	13	0	56	31	0	0	0	0	69
DAY_09	125	0	0	9.6	4.1	36	36	0	0	0	0	66
DAY_10	136	0	0	15	373	27	43	0	0	0	0	70
DAY_11	129	0	0	11	255	18	50	0	0	0	0	67
DAY_12	137	0	0	9.3	4730	31	57	0	0	0	0	50
DAY_13	149	0	0	6.1	120	27	63	0	0	0	0	47
DAY_14	155	0	0	7.1	350	22	64	0	0	0	0	48
DAY_15	155	0	0	15	5000	18	65	0	0	0	0	25
DAY_16	147	0	0	17	1000	15	67	0	0	0	0	4.6
DAY_17	146	0	0	13	120	12	69	0	0	0	0	0
DAY_18	145	0	0	16	110	11	71	0	0	0	0	0
DAY_19	143	0	0	18	100	9.8	76	0	0	0	0	0
DAY_20	129	0	0	17	90	12	72	0	0	0	0	0
DAY_21	123	0	0	14	80	11	49	0	0	0	0	0
DAY_22	120	0	0	9.9	75	23	39	0	0	0	0	0
DAY_23	114	0	0	5.8	59	62	23	0	0	0	11	15
DAY_24	68	0	0	5.3	59	33	8.2	0	0	0	28	16
DAY_25	61	0	0	7	55	23	0	0	0	0	49	13
DAY_26	64	0	0	9.6	36	35	0	0	0	0	199	16
DAY_27	65	0	0	5.4	34	38	0	0	0	0	138	18
DAY_28	64	0	3.1	3.3	31	18	0	0	0	0	102	20
DAY_29	64	0	241	2.2	27	15	0	0	0	0	102	19
DAY_30	66	0	36	3	---	14	0	0	0	0	102	19
DAY_31	41	---	20	3.5	---	13	---	0	---	0	102	---
MONTH_TOT	2748.38	85.96	300.10	518.40	12718.89	977.80	1008.20	0.00	0.00	0.00	833.00	1043.60
MONTH_MEAN	88.66	2.87	9.68	16.72	438.58	31.54	33.61	0.00	0.00	0.00	26.87	34.79
MONTH_MAX	155.00	21.00	241.00	200.00	5000.00	166.00	76.00	0.00	0.00	0.00	199.00	99.00
MONTH_MIN	0.00	0.00	0.00	2.20	0.00	9.80	0.00	0.00	0.00	0.00	0.00	0.00

Note: Above data obtained from local USGS office because the published record for the water year 1992 is incorrect.

SANTA YNEZ RIVER AT SOLVANG, CALIF.
1993 Water Year (cfs)
USGS gage #11128500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	25	8.1	2.8	33	370	1700	1720	170	35	11	5.2	0.09
DAY_02	22	7.4	3.4	35	340	1600	1540	180	28	12	6	1
DAY_03	20	6.7	3.9	33	320	1500	1290	200	22	12	5.7	2.5
DAY_04	21	6.2	4.6	31	308	1400	1260	190	17	13	5.5	3
DAY_05	22	5.6	5.2	30	258	1350	1150	170	14	14	5.2	1.4
DAY_06	22	5.1	5.1	54	274	1280	1050	140	11	14	5	0.15
DAY_07	22	4.7	26	100	311	1220	1040	115	15	13	4.8	0.07
DAY_08	21	4.3	19	35	7430	1180	994	92	20	12	4.5	0
DAY_09	20	3.8	13	14	6130	1120	920	76	13	11	4.3	0
DAY_10	20	3.5	10	12	2650	1100	750	66	18	9	4.7	0
DAY_11	22	3.4	9	7.9	1800	1000	600	76	30	9.7	5.1	0
DAY_12	24	3.2	8	10	1550	960	550	90	25	10	5.6	0
DAY_13	26	3.1	7	1180	1420	940	500	78	35	10	6.2	0
DAY_14	29	3	6.3	255	1040	860	600	70	36	10	5	0
DAY_15	38	3	5.6	58	727	760	550	80	38	9.2	4.5	0
DAY_16	38	3	5	5520	870	680	500	92	23	8.6	3.9	0
DAY_17	39	2.9	4.8	8000	769	620	480	110	13	9.2	3.4	0
DAY_18	40	2.9	4.8	5000	3900	560	460	80	14	9.6	3	0
DAY_19	42	2.9	4.5	3090	12600	600	450	100	15	10	2.4	0
DAY_20	42	3	4.4	2170	7230	660	410	92	7	11	2	0
DAY_21	30	3	4.4	2000	5380	700	370	70	15	9.5	1.6	0
DAY_22	20	3	4.3	1400	4300	570	340	47	13	8.6	1.2	0
DAY_23	17	3	4.3	1000	12100	450	300	60	11	7.9	0.9	0
DAY_24	13	3	4.2	680	6630	350	280	45	9.5	7.2	0.6	0
DAY_25	11	3	4.2	500	3620	550	255	60	8.4	6.6	0.3	0
DAY_26	10	3	8	600	3900	4000	240	54	9	7	0.08	0
DAY_27	9.2	3	15	480	2120	2700	220	45	10	7.6	0.04	0
DAY_28	8.5	3	25	420	2000	1600	200	56	9.5	6.7	0	0
DAY_29	8	2.9	5	380	---	950	180	70	9	6	0	0
DAY_30	8.6	2.8	40	410	---	700	160	60	10	5.6	0	0
DAY_31	9.2	---	31	430	---	1300	---	45	---	5	0	---
MONTH_TOT	699.50	115.50	297.80	33967.9	90347.0	34960.0	19359.0	2879.00	533.40	296.00	96.72	8.21
MONTH_MEAN	22.56	3.85	9.61	1095.7	3226.7	1127.7	645.3	92.87	17.78	9.55	3.12	0.27
MONTH_MAX	42.00	8.10	40.00	8000.0	12600.0	4000.0	1720.0	200.00	38.00	14.00	6.20	3.00
MONTH_MIN	8.00	2.80	2.80	7.9	258.0	350.0	160.0	45.00	7.00	5.00	0.00	0.00

Source: published data from USGS

SANTA YNEZ RIVER AT SOLVANG, CALIF.
1994 Water Year (cfs)
USGS gage #11128500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0	0	3.5	4.2	5.9	17	15	3.1	0.61	0	81	46
DAY_02	0	0	3.1	4.2	5.4	17	14	3.1	0.61	0	94	45
DAY_03	0	0.88	3	5.3	6.5	17	12	3.1	0.39	0	101	45
DAY_04	0	2.1	3.3	4.7	8.5	17	12	3	0.3	0	106	45
DAY_05	0	1.8	3.5	4.7	6.4	17	11	2.8	0.3	0	108	43
DAY_06	0	1.6	3.2	4.7	6.5	17	11	2.6	0.3	0	110	40
DAY_07	0	1.5	3.3	4.9	18	17	10	2.5	0.3	0	96	44
DAY_08	0	1.4	2.9	5.1	29	17	9.6	2.5	0.27	0	65	44
DAY_09	0	1.2	2.4	5.1	24	17	9.9	2.5	0.2	0	52	42
DAY_10	0	1.2	2.7	5.1	21	16	9.2	2.2	0.1	0	36	40
DAY_11	0	1.2	7.1	5.4	21	15	8.8	2.2	0.19	0	30	40
DAY_12	0	1.1	7	5.4	20	14	8.3	2.2	0.04	0	29	39
DAY_13	0	1.5	5.1	5.4	20	13	8.1	2.1	0.05	0	29	40
DAY_14	0	2	5.1	5.7	20	12	7.8	2	0.09	0	30	40
DAY_15	0	1.6	5.3	5.8	19	12	7.4	2	0	0	32	39
DAY_16	0	2.1	4.7	5.8	19	12	7	2	0	0	43	39
DAY_17	0	2.5	4.3	5.9	50	12	6.8	1.8	0.02	0	48	39
DAY_18	0	2.5	4	6.2	25	12	6.5	1.8	0.05	0	48	39
DAY_19	0	2.5	4.1	6.2	19	16	6.4	1.8	0.06	0	48	39
DAY_20	0	2.5	4.1	6.2	90	16	6.2	1.7	0.06	0	49	38
DAY_21	0	2.5	4	6.4	40	14	6.1	1.6	0.06	0	49	34
DAY_22	0	3	3.9	6.5	24	13	5.8	1.6	0.06	0	48	32
DAY_23	0	3	3.7	6.5	18	12	5.7	1.6	0.06	0	50	32
DAY_24	0	3.2	3.9	6.9	18	42	5.8	1.5	0.06	0	51	32
DAY_25	0	3.2	4.3	6.2	18	41	7.3	0.9	0.03	0	51	32
DAY_26	0	3.4	4	5.8	18	26	4.2	0.8	0	0	52	32
DAY_27	0	3.4	4.5	5.8	18	21	3	0.8	0	0	46	32
DAY_28	0	3.4	4.7	5.9	17	19	3.1	0.72	0	0	45	32
DAY_29	0	3.5	4.7	5.8	---	18	3.1	0.7	0	0.6	46	32
DAY_30	0	3.5	4.7	5.8	---	17	3.1	0.7	0	5.4	47	32
DAY_31	0	---	4.7	5.8	---	15	---	0.68	---	5.4	46	---
MONTH_TOT	0.00	63.28	128.80	173.40	605.20	541.00	234.20	58.60	4.21	11.40	1766.00	1148.00
MONTH_MEAN	0.00	2.11	4.15	5.59	21.61	17.45	7.81	1.89	0.14	0.37	56.97	38.27
MONTH_MAX	0.00	3.50	7.10	6.90	90.00	42.00	15.00	3.10	0.61	5.40	110.00	46.00
MONTH_MIN	0.00	0.00	2.40	4.20	5.40	12.00	3.00	0.68	0.00	0.00	29.00	32.00

Source: published data from USGS

SANTA YNEZ RIVER AT SOLVANG, CALIF.
1995 Water Year (cfs)
USGS gage #11128500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	32	3	2.9	3.5	2350	171	1170	278	73	100	0.35	0
DAY_02	32	3.4	2.9	2.7	1700	213	1110	273	70	88	0.21	0
DAY_03	32	3.4	3.3	8.9	1670	207	1080	216	75	86	0.12	0
DAY_04	34	3.1	4.3	78	1590	218	1170	212	68	80	0.1	0
DAY_05	37	3.1	5	66	1530	1850	1280	208	58	72	0.08	0
DAY_06	40	3.1	4.9	6.3	1400	2400	1210	203	51	56	0.06	0
DAY_07	43	5.4	4.2	71	1370	2700	976	161	47	34	0.02	0
DAY_08	47	5.5	1.7	60	1550	2230	972	162	47	24	0	0
DAY_09	49	5.4	2.3	1190	1550	618	759	156	49	20	0	0
DAY_10	49	5.3	2.2	13300	1560	4240	745	145	46	16	0	0
DAY_11	49	5.1	2.2	5650	1240	7420	728	149	46	15	0	0
DAY_12	49	5	2.4	3850	1190	6780	718	156	46	11	0	0
DAY_13	46	5.1	3.3	3080	1200	5830	580	145	45	10	0	0
DAY_14	42	5.1	4.6	3000	2320	5710	308	130	42	8.2	0	0
DAY_15	38	4.8	5	2700	1770	5680	703	183	43	6.7	0	0
DAY_16	35	4.7	5.4	2500	1570	5140	792	192	82	5.8	0	0
DAY_17	32	4.5	5.8	2300	1510	4720	602	172	87	3.5	0	0
DAY_18	29	4.4	4.6	2200	1450	3500	557	174	85	1.9	0	0
DAY_19	26	4.3	5.2	2400	1340	2450	524	175	82	1.5	0	0
DAY_20	24	4.1	5.5	2840	829	1330	481	175	81	0.93	0	0
DAY_21	21	4.1	6.6	2780	582	1420	445	175	89	0.69	0	0
DAY_22	19	4.1	5.7	3080	450	1600	421	174	99	0.66	0	0
DAY_23	17	4.1	5.3	4190	261	8050	421	134	129	0.6	0	0
DAY_24	14	3.9	6.7	10400	172	8020	429	128	134	0.73	0	0
DAY_25	12	3.8	6.8	10800	135	3220	383	125	139	0.81	0	0
DAY_26	9.9	3.7	5.2	9520	140	2290	297	157	145	0.63	0	0
DAY_27	8.2	3.5	4.7	6200	130	2070	294	175	135	0.49	0	0
DAY_28	6.6	3.5	5	5510	164	1810	273	175	125	0.39	0	0
DAY_29	5.2	3.2	4.4	4830	---	1540	249	175	123	0.34	0	0
DAY_30	3.9	3.1	3.2	4520	---	1450	266	146	116	0.26	0	0
DAY_31	2.8	---	2.9	3600	---	1340	---	95	---	0.33	0	---
MONTH_TOT	884.60	124.80	134.20	110736.4	32723.0	96217.0	19943.0	5324.0	2457.00	646.46	0.94	0.00
MONTH_MEAN	28.54	4.16	4.33	3572.1	1168.7	3103.8	664.8	171.7	81.90	20.85	0.03	0.00
MONTH_MAX	49.00	5.50	6.80	13300.0	2350.0	8050.0	1280.0	278.0	145.00	100.00	0.35	0.00
MONTH_MIN	2.80	3.00	1.70	2.7	130.0	171.0	249.0	95.0	42.00	0.26	0.00	0.00

Source: unpublished data from USGS

SANTA YNEZ RIVER AT SOLVANG, CALIF.
1996 Water Year (cfs)
USGS gage #11128500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0	1	4.6	6	19	38	13	0.87	0.83	---	---	---
DAY_02	0	1	4.6	6.1	10	32	13	0.87	0.83	---	---	---
DAY_03	0	1	4.6	6.2	13	27	12	0.85	0.83	---	---	---
DAY_04	0	1	4.8	6.2	14	28	11	0.83	---	---	---	---
DAY_05	0	1.1	4.8	6.3	35	29	10	0.83	---	---	---	---
DAY_06	0	1.3	4.7	6.3	73	29	9	0.83	---	---	---	---
DAY_07	0	1.5	4.6	6.3	43	22	9	0.83	---	---	---	---
DAY_08	0	1.5	4.7	6.3	34	19	9.2	0.83	---	---	---	---
DAY_09	0	1.6	4.8	6.3	28	17	9.2	0.83	---	---	---	---
DAY_10	0	1.3	4.6	6.2	23	16	8.6	0.83	---	---	---	---
DAY_11	0	1.4	4.6	6.2	20	15	7.8	0.83	---	---	---	---
DAY_12	0	1.5	5	6.3	18	28	6.8	0.83	---	---	---	---
DAY_13	0	1.8	5.4	6.3	16	101	6.2	0.83	---	---	---	---
DAY_14	0	2.1	5.2	6.3	15	56	5.7	0.83	---	---	---	---
DAY_15	0	2.3	5.2	6.3	15	34	5.1	0.83	---	---	---	---
DAY_16	0	2.6	5.4	7	14	27	4.9	0.83	---	---	---	---
DAY_17	0	2.9	5.3	6.8	12	22	5	0.83	---	---	---	---
DAY_18	0	3.3	5.3	6.4	12	20	4.6	0.83	---	---	---	---
DAY_19	0	3.9	5.6	6.5	46	18	4.1	0.83	---	---	---	---
DAY_20	0.12	4.1	5.6	6.4	793	17	3.6	0.83	---	---	---	---
DAY_21	0.27	4.3	5.8	6.3	435	17	3.2	0.83	---	---	---	---
DAY_22	0.3	4.4	5.5	6.9	272	16	3	0.83	---	---	---	---
DAY_23	0.34	4.4	6.1	6.4	146	15	2.4	0.83	---	---	---	---
DAY_24	0.4	4.4	5.9	6.3	94	15	1.8	0.83	---	---	---	---
DAY_25	0.48	4.4	5.7	6.7	73	14	1.3	0.83	---	---	---	---
DAY_26	0.57	4.4	5.9	6.4	63	13	1.2	0.83	---	---	---	---
DAY_27	0.59	4.4	5.7	6.3	59	14	1.1	0.83	---	---	---	---
DAY_28	0.67	4.6	5.9	6.3	62	13	1	0.83	---	---	---	---
DAY_29	0.79	4.5	5.9	6.2	45	13	0.95	0.83	---	---	---	---
DAY_30	0.93	4.6	6	6	---	12	0.91	0.83	---	---	---	---
DAY_31	0.91	---	6	9.8	---	12	---	0.83	---	---	---	---
MONTH_TOT	6.37	82.60	163.80	200.30	2502.00	749.00	174.66	25.83	---	---	---	---
MONTH_MEAN	0.21	2.75	5.28	6.46	86.28	24.16	5.82	0.83	---	---	---	---
MONTH_MAX	0.93	4.60	6.10	9.80	793.00	101.00	13.00	0.87	---	---	---	---
MONTH_MIN	0.00	1.00	4.60	6.00	10.00	12.00	0.91	0.83	---	---	---	---

Source: provisional data from USGS

Santa Ynez River Flow at Narrows

SANTA YNEZ RIVER AT NARROWS NEAR LOMPOC, CA
1991 Water Year
USGS gage #11133000

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
DAY_01	0	0	0	0	0	0	78	4.5	0.19	22	0	0
DAY_02	0	0	0	0	0	0	78	4.1	0.19	19	0	0
DAY_03	0	0	0	0	0	0	54	3.8	0.19	18	0	0
DAY_04	0	0	0	0	0	0	44	3.5	0.19	17	0	0
DAY_05	0	0	0	0	0	0	41	3.3	0.19	17	0	0
DAY_06	0	0	0	0	0	0	39	3.1	0.19	17	0	0
DAY_07	0	0	0	0	0	0	37	3	0.19	18	0	0
DAY_08	0	0	0	0	0	0	34	2.5	0.19	23	0	0
DAY_09	0	0	0	0	0	0	28	2.2	0.19	22	0	0
DAY_10	0	0	0	0	0	0	26	1.8	0.19	24	0	0
DAY_11	0	0	0	0	0	0	25	1.5	0.19	23	0	0
DAY_12	0	0	0	0	0	0	22	1.2	0.19	12	0	0
DAY_13	0	0	0	0	0	0	21	1.1	0.19	5	0	0
DAY_14	0	0	0	0	0	0	20	0.82	0.19	2	0	0
DAY_15	0	0	0	0	0	0	18	0.59	1.1	1.2	0	0
DAY_16	0	0	0	0	0	0	17	0.45	22	0.76	0	0
DAY_17	0	0	0	0	0	21	15	0.24	39	0.53	0	0
DAY_18	0	0	0	0	0	1150	13	0.19	46	0.45	0	0
DAY_19	0	0	0	0	0	3470	12	0.19	45	0.41	0	0
DAY_20	0	0	0	0	0	956	11	0.19	42	0.34	0	0
DAY_21	0	0	0	0	0	561	10	0.19	42	0.19	0	0
DAY_22	0	0	0	0	0	158	9.9	0.19	41	0.16	0	0
DAY_23	0	0	0	0	0	81	9.6	0.19	42	0.09	0	0
DAY_24	0	0	0	0	0	81	8.3	0.19	44	0.09	0	0
DAY_25	0	0	0	0	0	401	7.5	0.19	46	0.08	0.01	0.01
DAY_26	0	0	0	0	0	467	6.5	0.25	47	0.04	0.01	0
DAY_27	0	0	0	0	0	846	5.8	0.33	41	0.02	0.01	0
DAY_28	0	0	0	0	0	344	5.2	0.19	30	0.02	0.01	0
DAY_29	0	0	0	0	---	199	5.2	0.19	25	0.01	0	0
DAY_30	0	0	0	0	---	135	5.1	0.19	23	0.01	0	0
DAY_31	0	0	0	0	---	96	---	0.19	---	0	0	---
MONTH_TOT	0.00	0.00	0.00	0.00	0.00	8966.00	706.10	40.56	578.76	243.40	0.04	0.01
MONTH_MEAN	0.00	0.00	0.00	0.00	0.00	289.23	23.54	1.31	19.29	7.85	0.00	0.00
MONTH_MAX	0.00	0.00	0.00	0.00	0.00	3470.00	78.00	4.50	47.00	24.00	0.01	0.01
MONTH_MIN	0.00	0.00	0.00	0.00	0.00	0.00	5.10	0.19	0.19	0.00	0.00	0.00

Source: published data from USGS

SANTA YNEZ RIVER AT NARROWS NEAR LOMPOC, CA
1992 Water Year
USGS gage #11133000

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
DAY_01	0	30	0.8	2.4	20	119	94	17	9.4	1.7	0.41	49
DAY_02	0	26	0.77	1.9	19	136	91	16	9.1	1.6	0.19	58
DAY_03	0	20	0.74	2	19	145	85	16	8.5	1.6	0.12	43
DAY_04	0	17	0.7	2	18	120	83	17	8.2	1.2	0.1	35
DAY_05	0	14	0.65	532	17	218	75	18	7.7	1.1	0.02	36
DAY_06	0	12	0.6	390	19	641	70	18	7.5	0.99	0.01	38
DAY_07	0	9.7	0.55	171	22	358	65	18	6.6	0.78	0.02	39
DAY_08	0	7.5	0.5	102	19	233	61	18	6.4	0.81	0	42
DAY_09	0	6.4	0.44	85	19	185	59	17	5.7	0.65	0.03	44
DAY_10	0	5.6	0.4	72	308	163	56	16	5.3	0.67	0	44
DAY_11	0	4.5	0.3	62	1090	147	54	16	5.5	0.64	0	46
DAY_12	0	3.1	0.27	52	5590	137	52	16	5	0.58	0	47
DAY_13	0	2.7	0.22	45	2820	126	49	16	5	0.63	0	44
DAY_14	0	2.6	0.15	41	1130	117	47	16	4.8	0.68	0	38
DAY_15	4.2	2.3	0	38	3040	114	44	15	5	0.63	0	37
DAY_16	38	2.1	0	35	1430	109	41	15	4.9	0.75	0	35
DAY_17	57	2	0	33	767	102	38	15	4.6	0.9	0	28
DAY_18	69	1.7	0	31	512	97	36	15	4.4	1	0	21
DAY_19	75	1.6	0	30	390	93	34	14	4.2	1.4	0	16
DAY_20	84	1.5	0	28	331	101	32	13	4.3	1.5	0	13
DAY_21	79	1.4	0	26	286	129	32	12	3.7	1.5	0	11
DAY_22	73	1.3	0	25	249	154	30	11	3.3	1.3	0	8.7
DAY_23	74	1.3	0	25	208	416	28	9.2	3.1	1.5	0	7.2
DAY_24	75	1.2	0	24	178	264	27	8.7	3.1	0.89	0	6.6
DAY_25	66	1.1	0	24	159	178	25	8.5	2.7	0.79	0	7.5
DAY_26	50	1.1	0	24	162	146	23	8.8	2.5	0.89	0	13
DAY_27	44	1	0	23	165	195	21	9.1	2.2	0.76	0	16
DAY_28	39	0.94	0	22	138	147	21	8.7	2	0.76	0	19
DAY_29	35	0.9	244	21	123	111	20	9.1	1.8	0.78	0	20
DAY_30	33	0.85	341	20	---	104	18	9.4	1.8	0.55	4	21
DAY_31	31	---	5.5	20	---	99	---	9.6	---	0.49	32	---
MONTH_TOT	926.20	183.39	597.59	2009.30	19248.00	5404.00	1411.00	426.10	148.30	30.02	36.90	883.00
MONTH_MEAN	29.88	6.11	19.28	64.82	683.04	174.32	47.03	13.75	4.94	0.97	1.19	29.43
MONTH_MAX	84.00	30.00	341.00	532.00	5590.00	641.00	94.00	18.00	9.40	1.70	32.00	58.00
MONTH_MIN	0.00	0.85	0.00	1.90	17.00	93.00	18.00	8.50	1.80	0.49	0.00	6.60

Source: published data from USGS

SANTA YNEZ RIVER AT NARROWS NEAR LOMPOC, CA
1993 Water Year
USGS gage #11133000

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	26	9	6.6	42	447	1790	1790	230	79	9.9	3.1	0.66
DAY_02	24	8.6	7.5	52	427	1550	1390	240	68	9.3	3.6	0.59
DAY_03	23	8.5	7.7	49	422	1550	1230	250	40	9.4	3.3	0.65
DAY_04	24	7.6	8.7	44	420	1530	1160	260	30	9	3	0.75
DAY_05	24	7.5	9.8	39	375	1420	1090	270	27	9.6	2.7	0.74
DAY_06	25	6.6	10	48	386	1430	956	260	23	9.1	2.6	0.88
DAY_07	24	6.6	65	130	381	1550	922	249	22	9.1	2.6	1.1
DAY_08	24	6.8	46	97	4020	1210	919	190	25	7.9	2.7	0.67
DAY_09	23	7.1	37	69	7310	1280	866	120	28	6.7	2.4	0.47
DAY_10	22	7	28	133	2860	1220	748	89	26	7	2.4	0.25
DAY_11	21	6.3	26	59	2210	1100	656	92	38	7.1	2.4	0.26
DAY_12	21	6.2	26	42	1880	1050	613	103	37	8.8	2.4	0.19
DAY_13	24	6.4	23	1500	1830	1010	564	108	44	9	3.1	0.24
DAY_14	26	6.6	20	1520	1630	876	621	100	44	9	3.4	0.42
DAY_15	26	6.3	19	561	1250	797	676	101	45	8.3	2.8	0.55
DAY_16	27	6.2	16	1470	1240	772	573	123	45	7.1	3.2	0.69
DAY_17	29	6.2	16	4000	1240	765	474	134	26	7.1	3.3	0.35
DAY_18	33	6.4	18	9430	3350	773	462	139	17	7.2	3.3	0.19
DAY_19	33	6.6	16	5760	11300	767	503	100	17	8.9	2.7	0.25
DAY_20	34	6.6	15	2780	7650	774	458	126	18	8.4	2.4	0.3
DAY_21	35	6.6	15	1870	3310	725	435	116	20	6.8	2.5	0.42
DAY_22	28	6.7	14	1300	2560	591	416	107	19	6.9	2	0.37
DAY_23	20	7.1	14	1090	7750	474	380	67	18	6	1.9	0.22
DAY_24	15	7.1	14	940	6680	449	345	87	15	5.4	2	0.16
DAY_25	13	7.1	14	732	2890	2040	305	74	13	4.8	1.8	0.16
DAY_26	12	7.1	14	634	3710	10600	277	82	11	4.9	1.5	0.16
DAY_27	10	7.1	14	686	2960	3100	260	75	10	4.9	1.4	0.17
DAY_28	10	7.1	15	514	2300	3540	240	69	10	5.6	1.1	0.17
DAY_29	9.1	7.1	75	430	---	2260	230	74	11	4.4	1	0.18
DAY_30	9.8	6.7	68	459	---	2070	230	88	11	3.9	0.91	0.18
DAY_31	10	---	52	492	---	1800	---	86	---	3.6	0.76	---
MONTH_TOT	684.90	208.80	730.30	36972.00	82788.00	50863.00	19789.00	4209.00	837.00	225.10	74.27	12.39
MONTH_MEAN	22.09	6.96	23.56	1192.65	2956.71	1640.74	659.63	135.77	27.90	7.26	2.40	0.41
MONTH_MAX	35.00	9.00	75.00	9430.00	11300.00	10600.00	1790.00	270.00	79.00	9.90	3.60	1.10
MONTH_MIN	9.10	6.20	6.60	39.00	375.00	449.00	230.00	67.00	10.00	3.60	0.76	0.16

Source: published data from USGS

SANTA YNEZ RIVER AT NARROWS NEAR LOMPOC, CA
1994 Water Year
USGS gage #11133000

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0	2.9	7.2	17	14	38	49	14	3	0.53	0	31
DAY_02	0	3	7.2	17	13	36	43	12	2.3	0.49	0	28
DAY_03	0	3	7.2	15	15	30	40	11	1.8	0.54	0	28
DAY_04	0	3.3	7.2	15	30	26	37	14	1.7	0.67	0	22
DAY_05	0	3.2	7.2	16	29	22	34	8.9	1.6	0.54	0	18
DAY_06	0	3	7.2	15	22	22	30	8.6	1.6	0.53	14	17
DAY_07	0.22	3.3	7.2	14	174	25	28	8.1	1.2	0.4	52	17
DAY_08	0.4	3.6	7.2	14	92	30	25	8.4	1.1	0.31	40	17
DAY_09	0.5	3.6	7.2	14	63	34	25	7.8	1	0.21	24	17
DAY_10	0.6	3.6	7.2	14	50	38	25	7.5	0.87	0.18	20	14
DAY_11	0.7	4.5	24	14	39	38	24	7.6	0.81	0.26	15	14
DAY_12	0.8	5.1	44	14	29	36	20	7.3	0.78	0.29	9.8	17
DAY_13	0.7	5.3	44	13	22	32	19	7.1	0.7	0.29	6.4	20
DAY_14	0.35	5.5	48	13	21	31	18	6.7	0.75	0.28	4.5	22
DAY_15	0.41	5.7	49	13	18	27	18	6.4	0.65	0.39	4.4	23
DAY_16	0.46	5.7	46	12	17	25	18	5.8	0.67	0.39	5.5	20
DAY_17	0.72	5.7	39	11	565	24	17	6.7	0.62	0.3	11	21
DAY_18	0.74	5.7	34	12	89	22	17	7	0.49	0.22	20	24
DAY_19	1.2	5.7	30	12	43	28	17	6.5	0.46	0.39	22	28
DAY_20	1.4	5.7	28	12	921	31	16	5.9	0.74	0.31	22	29
DAY_21	1.6	6	27	12	137	25	16	5.6	0.82	0.23	24	29
DAY_22	1.8	6.1	25	12	85	21	18	5.3	0.74	0.24	28	30
DAY_23	2	6.1	24	15	77	19	20	5.2	0.6	0.12	29	26
DAY_24	2.1	6.1	21	25	76	127	22	5.2	0.52	0.07	28	22
DAY_25	2.2	6	20	54	76	152	24	5.1	0.48	0.1	26	19
DAY_26	2.3	5.7	20	43	55	106	26	4.9	0.45	0.06	27	19
DAY_27	2.4	5.7	20	33	41	84	22	4.6	0.45	0.05	27	19
DAY_28	2.5	5.2	18	25	40	71	20	4.2	0.39	0	32	19
DAY_29	2.6	5.3	18	19	---	64	18	3.7	0.5	0	35	19
DAY_30	2.7	7.2	18	16	---	59	16	3.6	0.57	0	39	18
DAY_31	2.8	---	18	16	---	53	---	3.4	---	0	36	---
MONTH_TOT	34.20	146.50	687.00	547.00	2853.00	1376.00	722.00	218.10	28.36	8.39	601.60	647.00
MONTH_MEAN	1.10	4.88	22.16	17.65	101.89	44.39	24.07	7.04	0.95	0.27	19.41	21.57
MONTH_MAX	2.80	7.20	49.00	54.00	921.00	152.00	49.00	14.00	3.00	0.67	52.00	31.00
MONTH_MIN	0.00	2.90	7.20	11.00	13.00	19.00	16.00	3.40	0.39	0.00	0.00	14.00

Source: published data from USGS

SANTA YNEZ RIVER AT NARROWS NEAR LOMPOC, CA
1995 Water Year
USGS gage #11133000

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	17	7.2	9	13	1200	184	1080	309	169	76	10	19
DAY_02	16	8.1	9	12	950	188	1010	341	147	71	8.8	9.8
DAY_03	16	4.4	9	34	750	353	1030	347	133	73	8.3	4.7
DAY_04	17	4.1	9	1280	640	449	903	340	128	82	8.5	5
DAY_05	19	3.7	9	537	530	2740	883	340	144	82	9.2	5.4
DAY_06	20	3.4	8.9	116	450	4950	871	343	114	74	11	4.9
DAY_07	19	3.4	8.2	704	380	4860	801	315	108	57	9.4	4.5
DAY_08	16	3.6	7.8	357	330	4730	748	312	106	45	9.5	4.7
DAY_09	15	3.5	9	767	290	2630	651	304	99	36	10	5
DAY_10	14	9.7	9	10700	250	6300	605	298	94	30	8.9	9.5
DAY_11	12	9.6	9.2	5570	230	14000	666	295	90	26	7.9	8.8
DAY_12	10	9.7	9.8	5030	210	8610	658	310	85	24	8	6.8
DAY_13	18	9.5	10	4050	190	3480	588	294	86	21	20	5.4
DAY_14	30	8.9	9.9	3060	1580	4300	324	247	77	18	17	4.2
DAY_15	35	8.6	11	2630	950	5200	488	294	76	16	23	5.7
DAY_16	38	9.3	11	2700	660	4460	601	364	88	15	21	4.5
DAY_17	39	9	11	2140	500	4180	605	301	116	15	18	2.9
DAY_18	43	9.7	11	1960	430	2600	522	295	109	13	13	2.7
DAY_19	43	9	11	1720	370	1580	500	300	114	12	12	2.8
DAY_20	35	9	9.9	1760	335	1050	429	295	109	10	14	2.7
DAY_21	29	9	9.8	1300	305	1120	439	269	103	9.8	15	2.1
DAY_22	24	9	9.8	1550	280	1140	393	291	96	9.6	12	2.1
DAY_23	20	9	10	2820	260	6960	407	275	90	8.3	9.3	2.4
DAY_24	16	9	12	6700	240	6360	424	238	88	8.9	12	2.4
DAY_25	14	8.8	13	9320	235	1720	413	223	86	8.4	14	2.7
DAY_26	12	8.9	13	9410	230	1380	314	234	84	9.1	10	2.9
DAY_27	11	8	13	7470	220	1440	277	267	81	7.4	16	3.2
DAY_28	9.8	8	13	6310	217	1350	315	268	77	6.7	12	3.4
DAY_29	9.2	9	13	3860	---	1210	311	275	72	10	11	3.6
DAY_30	8	9	13	1910	---	1120	371	262	73	14	20	3.5
DAY_31	7.2	---	13	1520	---	1130	---	208	---	12	23	---
MONTH_TOT	632.20	231.10	324.30	97310.0	13212.0	101774.0	17627.0	***9054.0***	3042.0	900.20	401.80	147.30
MONTH_MEAN	20.39	7.70	10.46	3139.0	471.9	3283.0	587.6	292.1	101.4	29.04	12.96	4.91
MONTH_MAX	43.00	9.70	13.00	10700.0	1580.0	14000.0	1080.0	364.0	169.0	82.00	23.00	19.00
MONTH_MIN	7.20	3.40	7.80	12.0	190.0	184.0	277.0	208.0	72.0	6.70	7.90	2.10

Source: unpublished data from USGS
Calculated total in May does not match USGS calculated total.

SANTA YNEZ RIVER AT NARROWS NEAR LOMPOC, CA
1996 Water Year
USGS gage #11133000

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	3.2	7.1	17	32	95	60	2.3	0	2.9	0.19	20	9.8
DAY_02	3.8	7.2	22	32	100	51	2.5	0	2.7	0.16	19	7.7
DAY_03	5.9	6.5	21	29	104	45	1.8	0	2.7	0.16	19	6.5
DAY_04	6.4	5.6	22	25	123	40	1.5	0	2.7	0.17	20	6.4
DAY_05	6.5	6.9	22	21	138	46	1.2	0	2.4	0.17	21	6
DAY_06	5.7	9.6	17	21	162	34	1	0	1.9	0.21	23	5.7
DAY_07	5.4	15	14	21	158	28	0.7	0	0.78	0.21	25	5.2
DAY_08	2.8	14	14	23	105	21	0.49	0	0.78	0.24	25	4.9
DAY_09	3	14	14	22	93	16	0.37	0	0.74	0.26	24	4.7
DAY_10	3.1	14	14	20	84	12	0.11	0	1	0.26	25	4.8
DAY_11	3.1	15	15	19	79	8.8	0	0	0.74	0.26	27	4.2
DAY_12	3.2	18	21	19	73	25	0	4.9	0.78	0.31	31	15
DAY_13	3.1	21	47	20	85	73	0	4.9	1	0.36	31	18
DAY_14	3	20	34	20	57	58	0	4.6	1.1	0.44	29	17
DAY_15	2.7	18	31	20	54	41	0	4.4	0.98	0.44	29	17
DAY_16	2.7	18	30	22	55	28	0	4.2	0.84	0.48	29	17
DAY_17	3.1	22	30	26	50	20	0	4.2	0.88	0.54	25	17
DAY_18	2.8	24	30	29	48	13	0	4.2	0.85	0.56	23	17
DAY_19	2.7	26	33	32	65	8.8	0	3.9	0.7	0.58	21	17
DAY_20	2.7	25	31	32	2460	7	0	3.9	0.84	0.6	22	14
DAY_21	3.2	19	31	32	1410	6.5	0	3.8	0.58	0.62	22	13
DAY_22	4.6	13	30	39	471	5.3	0	3.6	0.55	0.64	22	13
DAY_23	6.5	15	30	38	220	4.8	0	3.6	0.51	0.66	21	14
DAY_24	5.8	21	29	38	154	4.3	0	3.6	0.6	0.46	20	14
DAY_25	5.5	22	30	40	123	4.2	0	3.6	0.63	0.37	20	15
DAY_26	5.3	22	30	45	101	4	0	3.3	0.62	0.26	27	15
DAY_27	5.3	20	30	47	115	3.5	0	3.2	0.62	0.34	31	18
DAY_28	5.3	19	30	48	108	3.4	0	3.2	0.43	7.5	32	18
DAY_29	4.6	18	30	44	71	3	0	3	0.21	35	30	19
DAY_30	4.2	16	29	42	---	2.3	0	3	0.21	43	19	22
DAY_31	5.6	---	30	60	---	2	0	3	---	27	14	---
MONTH_TOT	130.80	***491.90***	808.00	958.00	***6961.00***	678.90	11.97	76.10	32.27	122.45	746.00	375.90
MONTH_MEAN	4.09	16.40	26.06	30.90	246.07	21.90	0.40	2.45	1.08	3.95	24.06	12.53
MONTH_MAX	6.50	26.00	47.00	60.00	2460.00	73.00	2.50	4.90	2.90	43.00	32.00	22.00
MONTH_MIN	0.00	5.60	14.00	19.00	48.00	2.00	0.00	0.00	0.21	0.16	14.00	4.20

Source: provisional data from USGS
Calculated totals in November and February do not match USGS calculated total.

Salsipuedes Creek Flow

SALSIPUEDES CREEK NEAR LOMPOC CA
1991 Water Year (cfs)
USGS gage # 11132500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0.04	0.03	0.05	0.08	0.08	17	8	0.72	0.26	0.17	0.11	0.05
DAY_02	0.05	0.03	0.05	0.09	0.1	0.85	6	0.69	0.25	0.15	0.11	0.05
DAY_03	0.04	0.03	0.06	0.11	0.1	0.34	4	0.68	0.26	0.14	0.11	0.05
DAY_04	0.04	0.03	0.06	0.16	0.08	0.51	3.2	0.67	0.26	0.14	0.12	0.06
DAY_05	0.04	0.03	0.06	0.11	0.08	1	3	0.63	0.27	0.14	0.11	0.06
DAY_06	0.05	0.03	0.06	0.13	0.08	0.32	2.7	0.57	0.26	0.13	0.1	0.06
DAY_07	0.04	0.03	0.07	0.06	0.08	0.24	2.5	0.56	0.24	0.13	0.1	0.06
DAY_08	0.04	0.03	0.06	0.07	0.09	0.24	2.3	0.49	0.24	0.13	0.1	0.06
DAY_09	0.03	0.03	0.06	0.08	0.1	0.23	2	0.48	0.24	0.13	0.09	0.06
DAY_10	0.04	0.03	0.06	0.07	0.11	0.22	1.8	0.48	0.24	0.14	0.1	0.06
DAY_11	0.03	0.03	0.06	0.07	0.21	0.23	1.6	0.42	0.24	0.14	0.09	0.06
DAY_12	0.03	0.03	0.06	0.07	0.24	0.21	1.5	0.43	0.25	0.14	0.08	0.06
DAY_13	0.03	0.04	0.06	0.07	0.24	0.29	1.5	0.48	0.25	0.14	0.1	0.06
DAY_14	0.03	0.03	0.06	0.08	0.31	0.28	1.4	0.49	0.22	0.14	0.08	0.07
DAY_15	0.03	0.04	0.08	0.08	0.32	0.27	1.4	0.48	0.21	0.14	0.08	0.07
DAY_16	0.03	0.04	0.07	0.08	0.32	0.28	1.3	0.47	0.19	0.15	0.07	0.07
DAY_17	0.03	0.04	0.06	0.07	0.32	99	1.3	0.43	0.18	0.15	0.07	0.07
DAY_18	0.03	0.05	0.06	0.07	0.32	1230	1.3	0.39	0.18	0.15	0.07	0.07
DAY_19	0.04	0.05	0.07	0.07	0.32	164	1.4	0.39	0.17	0.15	0.07	0.07
DAY_20	0.03	0.05	0.1	0.07	0.32	101	1.4	0.39	0.17	0.12	0.07	0.07
DAY_21	0.03	0.05	0.09	0.07	0.32	93	1.4	0.39	0.17	0.12	0.07	0.08
DAY_22	0.03	0.05	0.08	0.07	0.32	27	1.3	0.38	0.17	0.11	0.06	0.09
DAY_23	0.03	0.05	0.07	0.07	0.34	10	1.2	0.37	0.17	0.12	0.06	0.09
DAY_24	0.03	0.05	0.07	0.07	0.34	40	1.1	0.32	0.17	0.13	0.06	0.09
DAY_25	0.03	0.05	0.08	0.07	0.33	70	0.97	0.31	0.17	0.13	0.05	0.08
DAY_26	0.03	0.06	0.07	0.07	0.35	118	0.94	0.28	0.17	0.13	0.05	0.09
DAY_27	0.03	0.06	0.08	0.08	0.42	85	0.94	0.27	0.18	0.12	0.05	0.1
DAY_28	0.03	0.06	0.08	0.08	3.1	29	0.94	0.27	0.2	0.11	0.05	0.09
DAY_29	0.03	0.05	0.08	0.08	---	15	0.8	0.28	0.21	0.1	0.05	0.09
DAY_30	0.03	0.05	0.08	0.08	---	12	0.77	0.3	0.2	0.1	0.05	0.08
DAY_31	0.03	---	0.08	0.08	---	10	---	0.32	---	0.1	0.05	---
MONTH_TOT	1	1.2	2.1	2.5	9.3	2126	60	14	6.4	4.1	2.4	2.1
MONTH_MEAN	0.03	0.04	0.07	0.08	0.33	69	2	0.45	0.21	0.13	0.08	0.07
MONTH_MAX	0.05	0.06	0.1	0.16	3.1	1230	8	0.72	0.27	0.17	0.12	0.1
MONTH_MIN	0.03	0.03	0.05	0.06	0.08	0.21	0.77	0.27	0.17	0.1	0.05	0.05

Source: published data from USGS

SALSIPUEDES CREEK NEAR LOMPOC CA
1992 Water Year (cfs)
USGS gage # 11132500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0.07	0.06	0.08	1.4	0.48	6.4	8.6	2.2	2.2	1.2	0.51	0.28
DAY_02	0.06	0.06	0.09	0.58	0.52	12	8.1	2.4	2	1.3	0.43	0.25
DAY_03	0.06	0.06	0.09	0.47	0.51	8.6	7.8	2.4	1.7	1.4	0.4	0.24
DAY_04	0.06	0.06	0.09	0.42	0.51	6.4	7.3	2.6	1.6	1.2	0.35	0.28
DAY_05	0.06	0.06	0.08	45	0.53	118	7	2.8	1.7	0.99	0.34	0.28
DAY_06	0.06	0.06	0.09	13	2.8	88	6.7	2.9	2	0.81	0.36	0.26
DAY_07	0.06	0.06	0.1	7.5	2.5	48	6.3	3	1.8	0.71	0.36	0.28
DAY_08	0.06	0.05	0.1	5.1	1.3	24	6.1	3.2	1.6	0.67	0.32	0.27
DAY_09	0.06	0.06	0.09	2.8	9.8	16	5.4	3.7	1.4	0.7	0.3	0.29
DAY_10	0.05	0.06	0.09	1.9	88	13	5.3	3.9	1.5	0.75	0.28	0.3
DAY_11	0.05	0.06	0.09	1.3	40	12	5.3	3.7	1.6	0.88	0.29	0.29
DAY_12	0.05	0.06	0.09	0.74	1050	10	4.9	4.1	1.4	1.3	0.31	0.29
DAY_13	0.05	0.06	0.09	0.51	169	9.5	4.8	4.2	1.1	2.3	0.29	0.3
DAY_14	0.05	0.06	0.09	0.46	46	8.9	4.5	4.3	1	1.5	0.28	0.3
DAY_15	0.05	0.06	0.09	0.43	515	8.4	4.1	4.6	1.1	1.1	0.28	0.3
DAY_16	0.05	0.06	0.09	0.43	88	7.9	3.9	5.1	1.2	0.9	0.26	0.29
DAY_17	0.05	0.07	0.1	0.51	53	7.4	4	5	1.2	0.78	0.26	0.29
DAY_18	0.05	0.07	0.11	0.51	33	7.2	3.2	5	1.2	0.66	0.25	0.31
DAY_19	0.05	0.06	0.11	0.48	25	7.1	3.1	5.1	1.3	0.56	0.25	0.32
DAY_20	0.06	0.07	0.11	0.42	21	14	3.1	5.1	1.3	0.52	0.26	0.32
DAY_21	0.06	0.07	0.12	0.44	16	13	2.8	5.2	1.2	0.51	0.27	0.35
DAY_22	0.06	0.07	0.14	0.44	13	35	2.6	5.3	1.1	0.48	0.26	0.36
DAY_23	0.06	0.07	0.15	0.44	11	63	2.4	5.1	1.1	0.51	0.27	0.37
DAY_24	0.06	0.07	0.15	0.44	9.9	19	2.2	4.9	1	0.52	0.26	0.41
DAY_25	0.06	0.07	0.15	0.47	8.9	14	2.2	4.6	1	0.53	0.27	0.41
DAY_26	0.09	0.07	0.15	0.51	8.1	13	2.2	4.5	1	0.54	0.27	0.4
DAY_27	0.07	0.07	1	0.45	7.5	13	2	4.6	1.2	0.56	0.31	0.47
DAY_28	0.06	0.07	3.6	0.44	6.7	11	2	4.5	1.3	0.59	0.35	0.71
DAY_29	0.06	0.07	36	0.44	6.2	9.8	2.2	4.1	1.3	0.61	0.34	0.93
DAY_30	0.06	0.08	8.9	0.44	---	10	2	3.5	1.2	0.63	0.25	1.2
DAY_31	0.06	---	2	0.44	---	9.4	---	2.4	---	0.57	0.25	---
MONTH_TOT	1.8	1.9	54	89	2234	643	132	124	41	26	9.5	11
MONTH_MEAN	0.06	0.06	1.7	2.9	77	21	4.4	4	1.4	0.85	0.31	0.38
MONTH_MAX	0.09	0.08	36	45	1050	118	8.6	5.3	2.2	2.3	0.51	1.2
MONTH_MIN	0.05	0.05	0.08	0.42	0.48	6.4	2	2.2	1	0.48	0.25	0.24

Source: published data from USGS

SALSIPUEDES CREEK NEAR LOMPOC CA
1993 Water Year (cfs)
USGS gage # 11132500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	1.3	0.66	0.69	3.8	11	59	41	7.2	4.9	3.3	1.5	1.3
DAY_02	1.8	0.41	0.76	7.1	11	51	37	7.3	4.8	3.5	1.4	1.2
DAY_03	1.2	0.36	0.85	4.1	9.8	47	33	7.2	4.6	3	1.5	1.4
DAY_04	0.23	0.31	1	3.6	9.3	42	31	7.5	4.9	2.9	1.3	1.3
DAY_05	0.22	0.34	1	3.4	10	37	30	7.2	5.3	2.8	1.4	1.1
DAY_06	0.23	0.34	3.3	12	9	34	28	7.4	4.8	3	1.6	1.2
DAY_07	0.24	0.37	24	53	19	32	26	7.4	4.8	3.1	1.7	1.4
DAY_08	0.25	0.43	4	13	285	30	25	7.3	4.8	3.3	1.7	1.5
DAY_09	0.25	0.53	1.9	7.3	100	29	24	7.2	4.6	3.3	1.5	1.3
DAY_10	0.31	0.49	1.4	51	50	28	23	7.1	4.7	3.2	1.5	1.4
DAY_11	0.32	0.45	2.8	12	31	26	22	7.7	4.8	3.2	1.6	1.3
DAY_12	0.39	0.48	3.4	14	26	25	20	7.8	5.1	3.3	1.7	1.5
DAY_13	0.44	0.49	1.9	486	22	24	19	7.5	4.4	3.4	1.8	1
DAY_14	0.44	0.46	1.3	84	21	23	19	6.9	4.1	3.1	1.8	1.5
DAY_15	0.33	0.47	1.2	97	18	22	19	7.1	4.3	3	1.5	1.5
DAY_16	0.32	0.47	1.2	59	17	20	18	7.1	4.4	2.9	1.5	1.5
DAY_17	0.31	0.47	1.6	299	16	21	17	7	4.3	2.8	1.4	1.4
DAY_18	0.33	0.48	2.3	219	986	20	17	7.2	4.3	2.2	0.97	1.3
DAY_19	0.38	0.45	2	85	294	19	8.2	7.1	4	2.4	1.1	1.2
DAY_20	0.33	0.42	1.7	49	147	19	8	7.2	4.3	2.4	1.1	1.3
DAY_21	0.37	0.37	1.8	38	74	19	7.7	7.4	4.5	2.3	1.2	1.3
DAY_22	0.35	0.39	1.8	31	66	18	7.7	7.5	4.4	2.2	1.3	1.4
DAY_23	0.27	0.47	2	25	688	18	7.9	7.6	4.1	2.3	1.2	1.4
DAY_24	0.25	0.47	2	21	122	18	7.6	8.1	3.5	2.6	1.2	1.2
DAY_25	0.3	0.45	2.2	18	130	351	7.7	8.5	3.6	2.4	1.4	1.1
DAY_26	0.3	0.4	2.2	16	495	126	7.4	8.6	3.4	2.1	1.2	1.1
DAY_27	0.35	0.4	2.5	15	110	267	7.7	8.7	3.4	1.9	1.1	1
DAY_28	0.38	0.42	2.7	14	78	149	7.3	8.5	3.8	2	1	0.94
DAY_29	0.36	0.6	28	13	---	67	7.4	8.5	3.6	2.1	1.1	0.99
DAY_30	0.71	0.65	6.4	12	---	53	7.5	8.7	3.3	1.9	1.3	0.96
DAY_31	0.94	---	4.1	12	---	46	---	6.9	---	1.7	1.4	---
MONTH_TOT	14	13	114	1777	3855	1740	541	234	130	84	43	38
MONTH_MEAN	0.46	0.45	3.7	57	138	56	18	7.6	4.3	2.7	1.4	1.3
MONTH_MAX	1.8	0.66	28	486	986	351	41	8.7	5.3	3.5	1.8	1.5
MONTH_MIN	0.22	0.31	0.69	3.4	9	18	7.3	6.9	3.3	1.7	0.97	0.94

Source: published data from USGS

SALSIPUEDES CREEK NEAR LOMPOC CA
1994 Water Year (cfs)
USGS gage # 11132500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	1.1	1.4	2	2	2	4.2	4.7	2.4	1.8	1.1	0.85	0.34
DAY_02	1.3	1.2	1.6	1.8	2	4	4.4	2.5	1.8	0.98	0.82	0.34
DAY_03	1.4	1.1	1.5	2	2.1	4	4.2	2.4	1.7	0.98	0.73	0.3
DAY_04	1.4	1.1	1.3	2	6.3	3.9	3.9	2.3	1.6	0.86	0.73	0.29
DAY_05	1.2	1.2	1.5	2	3.1	4.2	3.9	2.4	1.5	0.85	0.73	0.29
DAY_06	1.2	0.95	1.6	1.9	2.5	12	3.9	2.5	1.6	0.85	0.73	0.29
DAY_07	1.2	0.98	1.6	1.8	67	5.2	3.9	2.5	1.6	0.85	0.64	0.29
DAY_08	1.3	1.4	1.7	1.7	13	4.3	3.9	2.4	1.3	0.85	0.63	0.29
DAY_09	1.3	1.5	1.7	1.8	4.8	4.2	4.3	2.1	1.2	0.77	0.63	0.29
DAY_10	1.6	1.6	1.7	2	3.5	4	4	2	1.3	0.81	0.47	0.29
DAY_11	1.9	2.7	11	2	3.2	4	3.7	2	1.3	0.85	0.47	0.29
DAY_12	1.8	2.5	3.5	2	2.7	3.9	3.2	2	1.1	0.85	0.47	0.25
DAY_13	1.7	1.8	1.7	2	2.6	3.9	3.2	2	1.1	0.83	0.47	0.25
DAY_14	1.8	1.6	1.8	2.1	2.5	3.9	3.3	2	1.1	0.73	0.46	0.25
DAY_15	1.7	1.5	2.2	2.2	2.5	3.9	3	2.1	1.1	0.77	0.4	0.25
DAY_16	1.7	1.4	1.7	2.2	2.5	4	3.4	1.8	1.2	0.85	0.43	0.25
DAY_17	1.8	1.5	1.5	2.1	236	4.2	3.2	2.2	1.1	0.85	0.47	0.25
DAY_18	1.6	1.5	1.6	2.1	13	4.2	3	2.4	1.2	0.85	0.47	0.25
DAY_19	1.3	1.7	1.6	2.2	31	7.5	3.3	2.2	1.3	0.84	0.47	0.25
DAY_20	1.1	1.7	1.5	2.1	217	5.9	2.8	2	1.3	0.73	0.47	0.25
DAY_21	1.1	1.7	1.5	2	17	4.2	2.6	2	1.3	0.73	0.47	0.22
DAY_22	1.2	1.7	1.5	2	9.7	3.8	2.6	2	1.4	0.73	0.47	0.21
DAY_23	1.1	1.8	1.7	2.8	7.3	3.6	2.7	2	1.5	0.73	0.4	0.21
DAY_24	1.1	1.6	1.7	7	6.5	58	2.9	2	1.5	0.73	0.4	0.21
DAY_25	1.1	1.5	1.7	7.7	5.9	19	3.2	2.2	1.3	0.66	0.4	0.21
DAY_26	1.1	1.5	1.7	3.3	5.1	8.1	4.1	2.2	1.3	0.69	0.4	0.21
DAY_27	1	1.5	1.7	2.4	4.7	6	3.4	1.9	1.3	0.73	0.4	0.21
DAY_28	0.95	1.5	1.7	2.2	4.4	5.5	3.1	1.6	1.3	0.73	0.4	0.21
DAY_29	0.97	1.7	1.7	2	---	5.2	2.7	1.8	1.3	0.73	0.4	0.21
DAY_30	1	3.6	1.8	2	---	4.8	2.3	1.8	1.1	0.73	0.37	0.18
DAY_31	1.2	---	1.9	2	---	4.8	---	1.8	---	0.75	0.35	---
MONTH_TOT	41.22	48.43	62.90	75.40	679.90	218.40	102.80	65.50	40.50	24.99	16.00	7.63
MONTH_MEAN	1.33	1.61	2.03	2.43	24.28	7.05	3.43	2.11	1.35	0.81	0.52	0.25
MONTH_MAX	1.90	3.60	11.00	7.70	236.00	58.00	4.70	2.50	1.80	1.10	0.85	0.34
MONTH_MIN	0.95	0.95	1.30	1.70	2.00	3.60	2.30	1.60	1.10	0.66	0.35	0.18

Source: published data from USGS

SALSIPUEDES CREEK NEAR LOMPOC CA
1995 Water Year (cfs)
USGS gage # 11132500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0.18	0.31	0.71	0.5	58	22	50	15	9.6	8	3.2	2.8
DAY_02	0.18	0.34	0.76	0.8	50	21	46	15	9.7	8	3.2	2.8
DAY_03	0.18	0.36	0.81	9.9	45	20	44	14	10	7.7	3.3	2.9
DAY_04	1.6	0.35	0.87	354	52	25	40	14	10	8	3.1	2.9
DAY_05	1.2	0.31	0.85	43	62	682	37	14	9.3	7.6	3.1	3
DAY_06	0.98	0.37	0.84	7.5	80	169	35	13	9.3	6.2	3.2	3
DAY_07	0.82	0.51	0.73	356	95	90	34	13	8.9	5.4	3.1	3
DAY_08	0.6	0.35	0.67	218	107	70	31	13	9.1	5.4	3.2	3
DAY_09	0.51	0.37	0.76	294	85	1000	29	12	8.9	5.5	3.1	3
DAY_10	0.47	2.5	0.94	1850	75	2960	28	11	8.7	5.4	3.2	3
DAY_11	0.47	1.1	0.97	297	65	5390	26	11	8.5	4.9	3.6	3
DAY_12	0.47	0.48	1.2	173	80	2500	24	13	8.2	4.6	3.7	3
DAY_13	0.44	0.39	1.6	106	114	200	23	16	8.3	4.5	3.5	2.9
DAY_14	0.4	0.31	1.4	121	331	60	22	18	8.2	4.4	3.5	2.9
DAY_15	0.4	0.38	1.4	112	100	45	25	22	9.2	4.4	3.7	2.9
DAY_16	0.4	0.64	1.3	129	70	35	32	19	11	5.1	4.2	2.8
DAY_17	0.4	0.54	1.2	105	60	30	26	18	9.7	5.9	3.9	2.8
DAY_18	0.4	0.54	1.2	93	54	200	26	16	8.8	5.2	3.4	2.9
DAY_19	0.35	0.47	1.2	83	46	1400	24	14	8.2	4.8	3.8	2.8
DAY_20	0.31	0.47	1.1	311	42	700	23	13	8.1	5.3	3.6	2.8
DAY_21	0.31	0.47	1.1	118	38	300	22	13	7.7	5.5	3.8	2.9
DAY_22	0.31	0.47	1.2	182	34	150	21	13	7.5	4.9	3.5	2.8
DAY_23	0.36	0.52	1.2	831	32	140	19	13	7.3	4.2	3.7	2.9
DAY_24	0.4	0.56	1.7	984	30	130	19	12	7.6	4.1	3.5	2.8
DAY_25	0.31	0.57	2	1150	28	115	18	11	7.7	3.8	3.4	2.9
DAY_26	0.27	0.81	1.5	263	27	100	18	10	7.9	3.7	3.2	2.9
DAY_27	0.37	0.77	1.2	151	25	90	17	10	9.2	3.5	3.2	2.8
DAY_28	0.44	0.73	1	114	24	80	17	10	8	3.4	3	2.8
DAY_29	0.47	0.65	0.9	104	---	70	16	9.8	7.4	3.2	3	2.7
DAY_30	0.45	0.65	0.62	80	---	60	15	9.6	7.8	3.3	2.9	2.7
DAY_31	0.34	---	0.58	65	---	55	---	9.3	---	3.2	2.9	---
MONTH_TOT	14.79	17.29	33.51	8705.70	1909.00	16909.00	807.00	414.70	259.80	159.10	104.70	86.40
MONTH_MEAN	0.48	0.58	1.08	280.83	68.18	545.45	26.90	13.38	8.66	5.13	3.38	2.88
MONTH_MAX	1.60	2.50	2.00	1850.00	331.00	5390.00	50.00	22.00	11.00	8.00	4.20	3.00
MONTH_MIN	0.18	0.31	0.58	0.50	24.00	20.00	15.00	9.30	7.30	3.20	2.90	2.70

Source: unpublished data from USGS

SALSIPUEDES CREEK NEAR LOMPOC CA
1996 Water Year (cfs)
USGS gage # 11132500

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	2.7	2.5	2.4	2.8	9.5	9.9	7	2.7	1.9	---	---	---
DAY_02	2.7	2.5	2.4	2.7	7.4	9	7.1	2.7	1.8	---	---	---
DAY_03	2.7	2.5	2.4	2.7	15	8.4	5.8	2.7	1.7	---	---	---
DAY_04	2.7	2.5	2.4	3	8.3	10	5.5	2.6	1.7	---	---	---
DAY_05	2.7	2.5	2.4	3.2	9.9	14	5.1	2.5	1.7	---	---	---
DAY_06	2.7	2.5	2.4	3.5	8.1	8.8	5	2.5	1.8	---	---	---
DAY_07	2.7	2.5	2.4	2.8	7.8	7.9	5	2.5	1.8	---	---	---
DAY_08	2.7	2.5	2.4	2.8	7.8	7.8	5	2.5	1.7	---	---	---
DAY_09	2.6	2.5	2.4	2.8	7.8	7.2	4.9	2.5	1.6	---	---	---
DAY_10	2.6	2.5	2.4	2.8	8.2	8.6	4.6	2.5	1.4	---	---	---
DAY_11	2.6	2.5	2.5	3	8.2	6.6	4.4	2.3	1.4	---	---	---
DAY_12	2.6	2.5	6.9	3	8.2	26	4.3	2.5	1.5	---	---	---
DAY_13	2.6	2.5	7.5	3	8.2	36	4.3	2.5	1.6	---	---	---
DAY_14	2.6	2.5	3.3	3	8.2	12	4.2	2.5	1.5	---	---	---
DAY_15	2.6	2.5	2.8	3.2	8.2	9.6	3.8	2.5	1.5	---	---	---
DAY_16	2.6	2.5	2.8	3.4	8.2	9	4.4	5.4	1.6	---	---	---
DAY_17	2.6	2.5	2.6	3.8	8.6	8.5	4.2	3.5	1.6	---	---	---
DAY_18	2.6	2.5	2.6	3.3	8.6	8.2	4.8	2.7	1.6	---	---	---
DAY_19	2.6	2.5	2.7	3.6	52	7.8	3.9	2.6	1.5	---	---	---
DAY_20	2.6	2.5	2.8	3.3	308	7.7	3.6	2.5	1.5	---	---	---
DAY_21	2.6	2.5	2.6	3.6	76	7.4	3.6	2.5	1.6	---	---	---
DAY_22	2.6	2.5	2.7	4.4	31	7.1	3.5	2.5	1.4	---	---	---
DAY_23	2.6	2.5	3.2	4.3	16	6.6	3.5	2.5	1.5	---	---	---
DAY_24	2.6	2.5	2.7	4.6	12	6.4	3.4	2.5	1.5	---	---	---
DAY_25	2.6	2.5	3.1	4.9	10	6.3	3.3	2.5	1.5	---	---	---
DAY_26	2.6	2.5	2.8	5.2	10	6.3	3.1	2.5	1.6	---	---	---
DAY_27	2.6	2.5	2.6	5.5	38	6.3	3.1	2.6	1.5	---	---	---
DAY_28	2.6	2.5	2.8	6.2	22	6.3	3	2.7	1.4	---	---	---
DAY_29	2.6	2.4	2.7	6.5	12	5.9	3	2.7	1.2	---	---	---
DAY_30	2.6	2.4	3	6.6	---	5.9	2.7	2.6	0.95	---	---	---
DAY_31	2.6	---	2.9	15	---	5.7	---	2.3	---	---	---	---
MONTH_TOT	81.40	74.80	91.60	128.50	***743.20***	***293.20***	129.10	82.60	46.55	---	---	---
MONTH_MEAN	2.63	2.49	2.95	4.15	25.63	9.46	4.30	2.66	1.55	---	---	---
MONTH_MAX	2.70	2.50	7.50	15.00	308.00	36.00	7.10	5.40	1.90	---	---	---
MONTH_MIN	2.60	2.40	2.40	2.70	7.40	5.70	2.70	2.30	0.95	---	---	---

Source: provisional data from USGS
Calculated totals for February and March do not match USGS totals (provisional data).

Alamo Pintado Creek Flow
(Water Years 1991-1992)

ALAMO PINTADO CREEK NEAR SOLVANG
1991 Water Year (cfs)
USGS Gage #11128250

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0	0	0	0	0	0	0	0	0	0	0	0
DAY_02	0	0	0	0	0	0	0	0	0	0	0	0
DAY_03	0	0	0	0	0	0	0	0	0	0	0	0
DAY_04	0	0	0	0	0	0	0	0	0	0	0	0
DAY_05	0	0	0	31	0	7.1	0	0	0	0	0	0
DAY_06	0	0	0	1.2	0	20	0	0	0	0	0	0
DAY_07	0	0	0	0.17	0	0	0	0	0	0	0	0
DAY_08	0	0	0	0.01	0	0	0	0	0	0	0	0
DAY_09	0	0	0	0	0.06	0	0	0	0	0	0	0
DAY_10	0	0	0	0	9.4	0	0	0	0	0	0	0
DAY_11	0	0	0	0	19	0	0	0	0	0	0	0
DAY_12	0	0	0	0	177	0	0	0	0	0	0	0
DAY_13	0	0	0	0	159	0	0	0	0	0	0	0
DAY_14	0	0	0	0	40	0	0	0	0	0	0	0
DAY_15	0	0	0	0	201	0	0	0	0	0	0	0
DAY_16	0	0	0	0	94	0	0	0	0	0	0	0
DAY_17	0	0	0	0	24	0	0	0	0	0	0	0
DAY_18	0	0	0	0	9.7	0	0	0	0	0	0	0
DAY_19	0	0	0	0	7.3	0	0	0	0	0	0	0
DAY_20	0	0	0	0	6.4	0	0	0	0	0	0	0
DAY_21	0	0	0	0	5.9	0	0	0	0	0	0	0
DAY_22	0	0	0	0	5.3	0.07	0	0	0	0	0	0
DAY_23	0	0	0	0	2.1	0.05	0	0	0	0	0	0
DAY_24	0	0	0	0	0.28	0	0	0	0	0	0	0
DAY_25	0	0	0	0	0.21	0	0	0	0	0	0	0
DAY_26	0	0	0	0	0.16	0.03	0	0	0	0	0	0
DAY_27	0	0	0	0	0.09	0	0	0	0	0	0	0
DAY_28	0	0	0.8	0	0.03	0	0	0	0	0	0	0
DAY_29	0	0	30	0	0.03	0	0	0	0	0	0	0
DAY_30	0	0	2.3	0	---	0	0	0	0	0	0	0
DAY_31	0	---	0	0	---	0	---	0	---	0	0	---
MONTH_TOT	0.00	0.00	33.10	32.38	760.96	27.25	0.00	0.00	0.00	0.00	0.00	0.00
MONTH_MEAN	0.00	0.00	1.07	1.04	26.24	0.88	0.00	0.00	0.00	0.00	0.00	0.00
MONTH_MAX	0.00	0.00	30.00	31.00	201.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00
MONTH_MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: published data from USGS

ALAMO PINTADO CREEK NEAR SOLVANG

1992 Water Year (cfs)

USGS Gage #11128250, Discontinued in 1993

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0	0	0	0	0	0	0	0	0	0	0	0
DAY_02	0	0	0	0	0	0	0	0	0	0	0	0
DAY_03	0	0	0	0	0	0	0	0	0	0	0	0
DAY_04	0	0	0	0	0	0	0	0	0	0	0	0
DAY_05	0	0	0	0	0	0	0	0	0	0	0	0
DAY_06	0	0	0	0	0	0	0	0	0	0	0	0
DAY_07	0	0	0	0	0	0	0	0	0	0	0	0
DAY_08	0	0	0	0	0	0	0	0	0	0	0	0
DAY_09	0	0	0	0	0	0	0	0	0	0	0	0
DAY_10	0	0	0	0	0	0	0	0	0	0	0	0
DAY_11	0	0	0	0	0	0	0	0	0	0	0	0
DAY_12	0	0	0	0	0	0	0	0	0	0	0	0
DAY_13	0	0	0	0	0	0	0	0	0	0	0	0
DAY_14	0	0	0	0	0	0	0	0	0	0	0	0
DAY_15	0	0	0	0	0	0	0	0	0	0	0	0
DAY_16	0	0	0	0	0	0	0	0	0	0	0	0
DAY_17	0	0	0	0	0	0.05	0	0	0	0	0	0
DAY_18	0	0	0	0	0	249	0	0	0	0	0	0
DAY_19	0	0	0	0	0	112	0	0	0	0	0	0
DAY_20	0	0	0	0	0	19	0	0	0	0	0	0
DAY_21	0	0	0	0	0	7.8	0	0	0	0	0	0
DAY_22	0	0	0	0	0	0.83	0	0	0	0	0	0
DAY_23	0	0	0	0	0	0.14	0	0	0	0	0	0
DAY_24	0	0	0	0	0	2	0	0	0	0	0	0
DAY_25	0	0	0	0	0	42	0	0	0	0	0	0
DAY_26	0	0	0	0	0	65	0	0	0	0	0	0
DAY_27	0	0	0	0	0	44	0	0	0	0	0	0
DAY_28	0	0	0	0	0	2.1	0	0	0	0	0	0
DAY_29	0	0	0	0	0	0.25	0	0	0	0	0	0
DAY_30	0	0	0	0	---	0.02	0	0	0	0	0	0
DAY_31	0	---	0	0	---	0	---	0	---	0	0	---
MONTH_TOT	0.00	0.00	0.00	0.00	0.00	544.19	0.00	0.00	0.00	0.00	0.00	0.00
MONTH_MEAN	0.00	0.00	0.00	0.00	0.00	17.55	0.00	0.00	0.00	0.00	0.00	0.00
MONTH_MAX	0.00	0.00	0.00	0.00	0.00	249.00	0.00	0.00	0.00	0.00	0.00	0.00
MONTH_MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: published data from USGS

Miguelito Creek Flow

MIGUELITO CREEK AT LOMPOC CA
1991 Water Year (cfs)
USGS gage #11134800

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0.02	0.02	0.02	0	0.05	11	0.3	0.13	0.04	0.01	0.02	0
DAY_02	0.02	0.02	0.02	0	0.07	1.7	0.29	0.13	0.05	0.01	0.02	0
DAY_03	0.02	0.02	0.02	0.02	0.04	1.7	0.33	0.13	0.05	0.01	0.03	0
DAY_04	0.02	0.02	0.02	0.04	0.03	3.4	0.32	0.13	0.05	0.02	0.02	0
DAY_05	0.02	0.02	0.03	0	0.04	1.8	0.15	0.13	0.04	0.02	0.02	0
DAY_06	0.02	0.02	0.02	0.01	0.03	1.3	0.07	0.14	0.03	0.02	0.02	0
DAY_07	0.02	0.02	0.02	0.02	0.03	1.1	0.06	0.15	0.03	0.03	0.02	0
DAY_08	0.02	0.02	0.02	0.02	0.03	1.1	0.06	0.18	0.03	0.03	0.02	0
DAY_09	0.02	0.03	0.02	0.05	0.03	1.1	0.06	0.14	0.04	0.03	0.01	0
DAY_10	0.02	0.03	0.02	0	0.03	1.1	0.06	0.14	0.03	0.03	0.01	0
DAY_11	0.02	0.03	0.02	0	0.03	1	0.06	0.14	0.03	0.03	0.01	0
DAY_12	0.02	0.03	0.02	0	0.03	0.7	0.06	0.13	0.03	0.02	0	0
DAY_13	0.02	0.03	0.01	0	0.03	0.93	0.06	0.13	0.03	0.01	0	0
DAY_14	0.02	0.03	0	0.02	0.03	1.1	0.06	0.12	0.03	0.02	0	0
DAY_15	0.01	0.03	0.02	0.02	0.03	1.1	0.06	0.12	0.03	0.02	0	0.01
DAY_16	0.02	0.03	0.02	0.02	0.03	1.1	0.06	0.11	0.03	0.03	0	0.01
DAY_17	0.02	0.03	0.02	0	0.04	37	0.06	0.11	0.03	0.03	0	0.02
DAY_18	0.02	0.03	0.02	0.02	0.03	231	0.06	0.1	0.03	0.03	0	0.03
DAY_19	0.02	0.03	0.05	0.02	0.03	19	0.07	0.1	0.03	0.03	0	0.03
DAY_20	0.02	0.03	0.03	0.02	0.03	22	0.09	0.09	0.03	0.03	0	0.03
DAY_21	0.02	0.03	0.01	0.02	0.03	8.7	0.11	0.09	0.03	0.02	0	0.03
DAY_22	0.02	0.03	0	0.02	0.03	2.5	0.1	0.08	0.03	0.01	0	0.03
DAY_23	0.02	0.02	0	0.02	0.03	2.4	0.12	0.08	0.03	0.01	0	0.01
DAY_24	0.02	0.02	0	0.02	0.03	13	0.13	0.07	0.03	0.01	0.01	0.01
DAY_25	0.03	0.04	0.01	0.02	0.03	4.5	0.15	0.07	0.03	0.01	0	0.02
DAY_26	0.03	0.02	0.01	0.03	0.03	33	0.17	0.06	0.03	0.01	0.01	0.02
DAY_27	0.03	0.02	0	0.03	6	4.3	0.13	0.06	0.03	0.01	0	0.03
DAY_28	0.02	0.02	0	0.03	3	0.66	0.13	0.05	0.03	0.02	0.01	0.03
DAY_29	0.02	0.02	0	0.03	---	0.3	0.13	0.05	0.03	0.01	0.01	0.04
DAY_30	0.02	0.02	0	0.04	---	0.14	0.13	0.05	0.02	0.01	0	0.03
DAY_31	0.02	---	0	0.05	---	0.11	---	0.05	---	0.01	0	---
MONTH_TOT	0.64	0.76	0.45	0.59	9.87	409.84	3.64	3.26	0.98	0.59	0.24	0.38
MONTH_MEAN	0.02	0.03	0.01	0.02	0.35	13.22	0.12	0.11	0.03	0.02	0.01	0.01
MONTH_MAX	0.03	0.04	0.05	0.05	6.00	231.00	0.33	0.18	0.05	0.03	0.03	0.04
MONTH_MIN	0.01	0.02	0.00	0.00	0.03	0.11	0.06	0.05	0.02	0.01	0.00	0.00

Source: published data from USGS

MIGUELITO CREEK AT LOMPOC CA
1992 Water Year (cfs)
USGS gage #11134800

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0.03	0	0	2.1	0.02	0.04	0.13	0.06	0.03	0	0.01	0
DAY_02	0.02	0	0	1.3	0.02	0.26	0.13	0.06	0.03	0	0.01	0
DAY_03	0.02	0	0	0.69	0.03	0.09	0.13	0.07	0.03	0	0.01	0
DAY_04	0.03	0	0	0.39	0.05	0.03	0.16	0.07	0.03	0	0.01	0
DAY_05	0.02	0	0	24	0.05	12	0.14	0.07	0.02	0	0.01	0
DAY_06	0.02	0.01	0	1.8	0.6	4.8	0.13	0.09	0.03	0	0.01	0.02
DAY_07	0.02	0	0.07	0.53	0.07	1.4	0.12	0.07	0.04	0.01	0.01	0.03
DAY_08	0	0.02	0	0.12	0.05	0.43	0.11	0.08	0.02	0.02	0.01	0.03
DAY_09	0.01	0.03	0	0.05	9.4	0.23	0.1	0.08	0	0.03	0.01	0.02
DAY_10	0.02	0.04	0	0.04	18	0.13	0.1	0.06	0	0.02	0.01	0.02
DAY_11	0.03	0.03	0	0.03	7.8	0.08	0.1	0.08	0	0.02	0.01	0.02
DAY_12	0.01	0.03	0	0.03	107	0.08	0.18	0.07	0	0.03	0.01	0.02
DAY_13	0	0.03	0.01	0.02	28	0.06	0.12	0.08	0.01	0.03	0.01	0.02
DAY_14	0	0.02	0	0.02	5.3	0.06	0.07	0.08	0	0.03	0.01	0.02
DAY_15	0.01	0.01	0	0.01	46	0.05	0.07	0.08	0	0.03	0.01	0.02
DAY_16	0.01	0.01	0	0.01	5.1	0.05	0.1	0.08	0	0.02	0.01	0.03
DAY_17	0.01	0.03	0	0.01	2.4	0.05	0.07	0.07	0	0.01	0.01	0.03
DAY_18	0.01	0.02	0	0	1.1	0.05	0.1	0.07	0	0.02	0.01	0.03
DAY_19	0.01	0.01	0	0.03	0.43	0.06	0.07	0.06	0	0.02	0.01	0.03
DAY_20	0.01	0	0	0.03	0.23	0.61	0.11	0.03	0	0	0.01	0
DAY_21	0.01	0.01	0	0.03	0.13	0.27	0.11	0.02	0	0.01	0	0.02
DAY_22	0.02	0.01	0	0.03	0.07	4.1	0.12	0.02	0	0.02	0	0.04
DAY_23	0.02	0.01	0	0.06	0.04	6.2	0.11	0.05	0	0.02	0	0.04
DAY_24	0.02	0.02	0	0.01	0.02	0.85	0.08	0.06	0	0.02	0	0.06
DAY_25	0.02	0	0	0.01	0.02	0.6	0.08	0.05	0	0.02	0	0.02
DAY_26	0.72	0.01	0	0.01	0.02	0.48	0.08	0.02	0	0.02	0	0.01
DAY_27	0.02	0.02	14	0.01	0.02	0.32	0.08	0.01	0	0.02	0	0.02
DAY_28	0	0.02	1.4	0.01	0.02	0.19	0.1	0.02	0	0.02	0	0.01
DAY_29	0	0	14	0.01	0.02	0.13	0.13	0.02	0	0.02	0	0
DAY_30	0	0	2.8	0.01	---	0.16	0.09	0.03	0	0.02	0	0
DAY_31	0	---	7.7	0.01	---	0.14	---	0.03	---	0.02	0	---
MONTH_TOT	1.12	0.39	39.98	31.41	232.01	34.00	3.22	1.74	0.24	0.50	0.20	0.56
MONTH_MEAN	0.04	0.01	1.29	1.01	8.00	1.10	0.11	0.06	0.01	0.02	0.01	0.02
MONTH_MAX	0.72	0.04	14.00	24.00	107.00	12.00	0.18	0.09	0.04	0.03	0.01	0.06
MONTH_MIN	0.00	0.00	0.00	0.00	0.02	0.03	0.07	0.01	0.00	0.00	0.00	0.00

Source: published data from USGS

MIGUELITO CREEK AT LOMPOC CA
1993 Water Year (cfs)
USGS gage #11134800

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0	0.12	0.33	0.63	0.33	3.9	2	0.08	0.3	0.06	0.06	0.06
DAY_02	0	0.13	0.33	0.53	0.33	3.3	1.7	0.08	0.27	0.06	0.06	0.06
DAY_03	0	0.11	0.34	0.06	0.31	2.9	1.5	0.07	0.24	0.06	0.06	0.06
DAY_04	0	0.13	0.36	0.06	0.23	2.5	1.2	0.07	0.21	0.06	0.06	0.06
DAY_05	0.01	0.15	0.42	0.06	0.31	2.4	0.95	0.06	0.19	0.06	0.06	0.06
DAY_06	0.01	0.13	42	3.7	0.14	2.3	0.8	0.06	0.18	0.06	0.06	0.06
DAY_07	0.02	0.13	214	8.8	2.4	2	0.7	0.07	0.16	0.06	0.06	0.06
DAY_08	0.03	0.21	1.7	1.6	21	2	0.6	0.09	0.15	0.06	0.06	0.06
DAY_09	0.04	0.23	1.7	1.4	5.6	2	0.55	0.09	0.14	0.06	0.06	0.06
DAY_10	0.04	0.2	1.7	9.5	1.9	2	0.5	0.09	0.13	0.06	0.06	0.06
DAY_11	0.03	0.23	2.6	1.5	1.2	1.8	0.4	0.08	0.12	0.06	0.06	0.06
DAY_12	0.03	0.22	1.2	1.1	0.79	1.7	0.4	0.11	0.11	0.06	0.06	0.06
DAY_13	0.02	0.07	0.3	32	0.7	1.7	0.35	0.19	0.1	0.06	0.06	0.06
DAY_14	0.02	0.06	0.17	4.5	0.7	1.7	0.3	0.28	0.1	0.06	0.06	0.06
DAY_15	0.02	0.06	0.08	5.7	0.7	1.4	0.28	0.2	0.09	0.06	0.06	0.06
DAY_16	0.02	0.08	0.06	2.4	0.6	1.4	0.26	0.19	0.09	0.06	0.06	0.06
DAY_17	0.02	0.08	0.12	24	0.6	1.4	0.24	0.19	0.08	0.06	0.06	0.06
DAY_18	0.02	0.08	0.06	22	64	1.4	0.22	0.07	0.08	0.06	0.06	0.06
DAY_19	0.02	0.1	0.06	4.8	11	1.4	0.19	0.06	0.08	0.06	0.06	0.06
DAY_20	0.02	0.13	0.06	2.1	11	1.4	0.18	0.09	0.08	0.06	0.06	0.06
DAY_21	0.02	0.13	0.06	1.6	3.1	1.4	0.17	0.23	0.07	0.06	0.06	0.06
DAY_22	0.02	0.13	0.06	1.2	6.8	1.4	0.16	0.35	0.07	0.06	0.06	0.06
DAY_23	0.02	0.13	0.06	0.68	71	1.4	0.15	0.45	0.07	0.06	0.06	0.06
DAY_24	0.02	0.13	0.06	0.49	11	1.4	0.14	0.37	0.07	0.06	0.06	0.06
DAY_25	0.03	0.13	0.06	0.43	9.3	35	0.13	0.43	0.07	0.06	0.06	0.06
DAY_26	0.03	0.17	0.06	0.36	44	15	0.12	0.47	0.06	0.06	0.06	0.06
DAY_27	0.04	0.23	0.06	0.33	9.1	21	0.11	0.86	0.06	0.06	0.06	0.06
DAY_28	0.04	0.23	0.18	0.33	5.6	9.9	0.1	0.68	0.06	0.06	0.06	0.06
DAY_29	0.04	0.25	0.87	0.33	---	4.1	0.09	0.5	0.06	0.06	0.06	0.06
DAY_30	0.96	0.29	0.15	0.33	---	3.2	0.09	0.42	0.06	0.06	0.06	0.06
DAY_31	0.12	---	0.06	0.33	---	2.5	---	0.36	---	0.06	0.06	---
MONTH_TOT	1.71	4.47	269.27	132.85	283.74	136.90	14.58	7.34	3.55	1.86	1.86	1.80
MONTH_MEAN	0.06	0.15	8.69	4.29	10.13	4.42	0.49	0.24	0.12	0.06	0.06	0.06
MONTH_MAX	0.96	0.29	214.00	32.00	71.00	35.00	2.00	0.86	0.30	0.06	0.06	0.06
MONTH_MIN	0.00	0.06	0.06	0.06	0.14	1.40	0.09	0.06	0.06	0.06	0.06	0.06

Source: published data from USGS

MIGUELITO CREEK AT LOMPOC CA
1994 Water Year (cfs)
USGS gage #11134800

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0.06	0.13	2	1.4	0.6	0.6	0.33	0.33	0.52	0.33	0.66	0.11
DAY_02	0.06	0.13	2	1.4	0.6	0.6	0.33	0.33	0.46	0.23	0.57	0.13
DAY_03	0.06	0.13	2	1.4	0.87	0.6	0.33	0.33	0.36	0.31	0.43	0.13
DAY_04	0.06	0.13	2.1	1.4	1.3	0.6	0.33	0.33	0.33	0.33	0.23	0.13
DAY_05	0.06	0.13	2.5	1.6	0.6	2.8	0.33	0.33	0.33	0.33	0.23	0.13
DAY_06	0.06	0.13	2.8	2.2	0.88	3.4	0.33	0.33	0.43	0.33	0.21	0.13
DAY_07	0.06	0.18	2.8	2.4	6	2	0.33	0.45	0.43	0.33	0.11	0.18
DAY_08	0.06	0.26	2.7	2.2	3.1	1.3	0.45	0.35	0.43	0.33	0.08	0.23
DAY_09	0.06	0.32	2.4	2	2.8	0.7	1.2	0.37	0.43	0.33	0.08	0.23
DAY_10	0.06	0.47	2.4	2	2.8	0.47	0.68	0.64	0.38	0.33	0.1	0.23
DAY_11	0.06	0.61	5.9	1.7	2.5	0.44	0.5	0.62	0.32	0.33	0.13	0.23
DAY_12	0.06	0.45	1.2	2	2.4	0.33	0.43	0.67	0.23	0.25	0.13	0.23
DAY_13	0.06	0.34	0.7	1.8	2.4	0.33	0.5	0.98	0.23	0.23	0.13	0.23
DAY_14	0.06	0.38	1.3	2.2	2.4	0.33	0.56	1.3	0.23	0.29	0.13	0.18
DAY_15	0.06	0.43	1.5	2.3	2.4	0.33	0.68	1.7	0.32	0.33	0.1	0.13
DAY_16	0.07	0.44	1.3	2.2	2.4	0.33	0.62	1.4	0.33	0.33	0.08	0.13
DAY_17	0.06	0.6	1.1	2.4	18	0.23	0.56	1.9	0.33	0.38	0.08	0.09
DAY_18	0.06	0.7	1.1	2.4	3.7	0.23	0.5	1.6	0.33	0.43	0.08	0.13
DAY_19	0.06	0.7	1.1	2.4	10	0.83	0.45	1.6	0.33	0.43	0.07	0.13
DAY_20	0.06	0.7	1.1	2.3	20	0.34	0.39	1.7	0.33	0.57	0.06	0.13
DAY_21	0.07	0.99	1.1	2.4	2.9	0.33	0.33	1.4	0.33	0.62	0.06	0.13
DAY_22	0.08	1.5	1.1	2.4	2.8	0.33	0.33	1.4	0.33	0.66	0.06	0.08
DAY_23	0.08	1.7	1.1	2.5	3.4	0.33	0.34	1.5	0.33	0.7	0.06	0.08
DAY_24	0.08	1.7	1.1	5.5	3.3	10	0.34	1.5	0.42	1	0.07	0.11
DAY_25	0.08	1.7	1.1	1.5	2.8	0.76	0.54	0.78	0.43	0.71	0.06	0.13
DAY_26	0.08	1.7	1.1	1.1	1.9	0.57	0.59	0.68	0.43	0.79	0.08	0.13
DAY_27	0.08	2	1.1	0.98	1.4	0.43	0.33	0.69	0.43	2.2	0.08	0.08
DAY_28	0.08	2.2	1.1	0.7	0.9	0.43	0.33	0.71	0.39	2	0.08	0.08
DAY_29	0.08	3.2	1.1	0.61	---	0.41	0.33	0.71	0.33	1.3	0.08	0.08
DAY_30	0.08	2.1	1.4	0.6	---	0.33	0.33	0.66	0.33	1.1	0.08	0.08
DAY_31	0.08	---	1.4	0.6	---	0.33	---	0.66	---	0.94	0.08	---
MONTH_TOT	2.08	26.15	52.70	58.59	105.15	31.04	13.62	27.95	10.83	18.77	4.48	4.22
MONTH_MEAN	0.07	0.87	1.70	1.89	3.76	1.00	0.45	0.90	0.36	0.61	0.14	0.14
MONTH_MAX	0.08	3.20	5.90	5.50	20.00	10.00	1.20	1.90	0.52	2.20	0.66	0.23
MONTH_MIN	0.06	0.13	0.70	0.60	0.60	0.23	0.33	0.33	0.23	0.23	0.06	0.08

Source: published data from USGS

MIGUELITO CREEK AT LOMPOC CA
1995 Water Year (cfs)
USGS gage #11134800

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0.12	0.19	0.07	0.05	9.7	1.3	7.8	3.2	2.4	1.1	0.86	0.69
DAY_02	0.12	0.2	0.06	0.04	9.2	1.2	7.6	3.1	2.4	1.6	0.85	0.69
DAY_03	0.08	0.22	0.06	2.5	8.8	1.1	7.4	3	2.4	1.6	0.84	0.69
DAY_04	0.7	0.18	0.06	55	8.7	1	7.2	2.8	2.3	2.5	0.82	0.69
DAY_05	0.5	0.16	0.05	9	7.3	28	7	2.7	2.3	2	0.8	0.69
DAY_06	0.4	0.17	0.05	1.5	7	10	6.8	2.6	2.3	1.5	0.79	0.69
DAY_07	0.35	0.2	0.04	55	6.6	8	6.4	2.5	2.3	1.1	0.78	0.69
DAY_08	0.28	0.16	0.04	38	7.5	6.2	6.1	2.4	2.2	1.1	0.76	0.68
DAY_09	0.27	0.17	0.04	50	6	14	5.8	2.2	2.2	1.1	0.74	0.68
DAY_10	0.26	1.2	0.03	300	6.3	772	5.4	2.1	2.2	1	0.73	0.68
DAY_11	0.26	0.47	0.03	50	5.8	1170	5	2	2.1	1	0.73	0.68
DAY_12	0.25	0.21	0.2	30	5.9	455	4.7	2.4	2.1	0.95	0.73	0.68
DAY_13	0.25	0.14	0.08	20	5.6	133	4.4	2.8	2.1	0.91	0.73	0.68
DAY_14	0.25	0.14	0.04	16	21	28	4	3.5	2	0.88	0.72	0.67
DAY_15	0.24	0.13	0.04	13	4.4	22	5	4	2	0.85	0.72	0.67
DAY_16	0.24	0.13	0.04	9	2.3	21	6	3.8	9	1.1	0.72	0.67
DAY_17	0.24	0.12	0.04	7	2	21	4.9	3.6	2.4	1.4	0.72	0.67
DAY_18	0.24	0.12	0.04	5.5	1.9	80	4.8	3.4	2.4	1.3	0.72	0.67
DAY_19	0.23	0.12	0.04	4.4	1.9	250	4.7	3.2	1.9	1.2	0.72	0.67
DAY_20	0.23	0.11	0.04	53	1.8	120	4.5	3.1	1.6	1.3	0.71	0.66
DAY_21	0.23	0.11	0.04	7.4	1.8	50	4.4	3.1	1.5	1.4	0.71	0.66
DAY_22	0.22	0.1	0.04	24	1.7	22	4.3	3.1	1.4	1.2	0.71	0.66
DAY_23	0.22	0.1	0.04	68	1.6	14	4.2	3.1	1.6	1	0.71	0.66
DAY_24	0.22	0.1	0.26	136	1.6	10	4.1	2.7	1.8	0.99	0.71	0.66
DAY_25	0.22	0.09	0.3	126	1.5	10	4	2.7	1.5	0.97	0.71	0.66
DAY_26	0.21	0.09	0.17	25	1.4	9.2	3.8	2.6	1.5	0.96	0.7	0.65
DAY_27	0.21	0.08	0.12	17	1.4	9.2	3.7	2.6	1.3	0.94	0.7	0.65
DAY_28	0.21	0.08	0.1	16	1.3	8.9	3.6	2.6	1.2	0.92	0.7	0.65
DAY_29	0.2	0.08	0.09	13	---	8	3.4	2.5	1.1	0.91	0.7	0.65
DAY_30	0.2	0.07	0.07	12	---	8	3.3	2.5	1.1	0.9	0.7	0.65
DAY_31	0.2	---	0.06	11	---	8	---	2.5	---	0.88	0.7	---
MONTH_TOT	7.85	5.44	2.38	1174.39	142.00	3300.10	154.30	88.40	64.60	36.56	22.94	20.14
MONTH_MEAN	0.25	0.18	0.08	37.88	5.07	106.45	5.14	2.85	2.15	1.18	0.74	0.67
MONTH_MAX	0.70	1.20	0.30	300.00	21.00	1170.00	7.80	4.00	9.00	2.50	0.86	0.69
MONTH_MIN	0.08	0.07	0.03	0.04	1.30	1.00	3.30	2.00	1.10	0.85	0.70	0.65

Source: unpublished data from USGS

MIGUELITO CREEK AT LOMPOC CA
1996 Water Year (cfs)
USGS gage #11134800

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0	0.13	75	3.1	0.68	0	0	0	---	---	---	---
DAY_02	0	0.04	68	2.9	0.08	0	0	0	---	---	---	---
DAY_03	0	0	59	2.2	22	0	0	0	---	---	---	---
DAY_04	0	0	48	2.1	0.01	0	0	0	---	---	---	---
DAY_05	0	0	29	2.2	4.8	0	0	0	---	---	---	---
DAY_06	0	0	14	2.3	0	0	0	0	---	---	---	---
DAY_07	0	0	5.8	2.4	0	0	0	0	---	---	---	---
DAY_08	0	0	3	2.3	0	0	0	0	---	---	---	---
DAY_09	0	0	2.8	2.3	0	0	0	0	---	---	---	---
DAY_10	0	0.02	3.2	2.2	0	0	0	0	---	---	---	---
DAY_11	0	0	3.9	2.1	0	0	0	0	---	---	---	---
DAY_12	0	0	62	2.1	0	0	0	0	---	---	---	---
DAY_13	0	0	7.2	2.3	0	0	0	0	---	---	---	---
DAY_14	0	0	5.2	2.9	0	0	0	0	---	---	---	---
DAY_15	0	0.18	5.2	2.5	0	0	0	0	---	---	---	---
DAY_16	0	0	6.3	2.8	0	0	0	7	---	---	---	---
DAY_17	0	0	6.9	2.6	0	0	0	0	---	---	---	---
DAY_18	0	0	6.9	1.8	0	0	0	0	---	---	---	---
DAY_19	0	0.01	7.3	2.4	25	0	0	0	---	---	---	---
DAY_20	0	0.1	6.9	2.2	47	0	0	0	---	---	---	---
DAY_21	0	0	6.9	3.1	0.01	0	0	0	---	---	---	---
DAY_22	0	0	8.5	3.5	0	0	0	0	---	---	---	---
DAY_23	0	0.41	10	2	0	0	0	0	---	---	---	---
DAY_24	0	0.04	9.2	1.9	0	0	0	0	---	---	---	---
DAY_25	0	0.04	7	3.3	0	0	0	0	---	---	---	---
DAY_26	0	0.05	3	2.1	0	0	0	0	---	---	---	---
DAY_27	0	0.04	2.2	3	0.01	0	0	0	---	---	---	---
DAY_28	0	0.02	1.6	2.8	0	0	0	0	---	---	---	---
DAY_29	0	0.01	1.8	2.2	0	0	0	0	---	---	---	---
DAY_30	0	163	3.1	---	---	0	0	---	---	---	---	---
DAY_31	0	---	2.4	27	---	0	---	---	---	---	---	---
MONTH_TOT	0.00	164.09	481.30	98.60	99.59	0.00	0.00	7.00	---	---	---	---
MONTH_MEAN	0.00	5.47	15.53	3.18	3.43	0.00	0.00	0.23	---	---	---	---
MONTH_MAX	0.00	163.00	75.00	27.00	47.00	0.00	0.00	7.00	---	---	---	---
MONTH_MIN	0.00	0.00	1.60	0.00	0.00	0.00	0.00	0.00	---	---	---	---

Source: provisional data from USGS

Zaca Creek Flow
(Water Years 1991-1992)

ZACA CREEK NEAR BUELLTON
1991 Water Year (cfs)
USGS gage # 11129800

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0.01	0	0	0	0	0.5	1.1	0	0	0	0	0
DAY_02	0	0	0	0	0	0	0.83	0	0	0	0	0
DAY_03	0	0	0	0	0	0	0.37	0	0	0	0	0
DAY_04	0	0	0	0	0	0	0.17	0	0	0	0	0
DAY_05	0	0	0	0	0	0	0.15	0	0	0	0	0
DAY_06	0	0	0	0	0	0	0.13	0	0	0	0	0
DAY_07	0	0	0	0	0	0	0.1	0	0	0	0	0
DAY_08	0	0	0	0	0	0	0.07	0	0	0	0	0
DAY_09	0	0	0	0	0	0	0.07	0	0	0	0	0
DAY_10	0	0	0	0	0	0	0.08	0	0	0	0	0
DAY_11	0	0	0	0	0	0	0.06	0	0	0	0	0
DAY_12	0	0	0	0	0	0	0.05	0	0	0	0	0
DAY_13	0	0	0	0	0	0	0.05	0	0	0	0	0
DAY_14	0	0	0	0	0	0	0.05	0	0	0	0	0
DAY_15	0	0	0	0	0	0	0.03	0	0	0	0	0
DAY_16	0	0	0	0	0	0	0.01	0	0	0	0	0
DAY_17	0	0	0	0	0	0.61	0.01	0	0	0	0	0
DAY_18	0	0	0	0	0	28	0.01	0	0	0	0	0
DAY_19	0	0	0	0	0	87	0.01	0	0	0	0	0
DAY_20	0	0	0	0	0	45	0.03	0	0	0	0	0
DAY_21	0	0	0	0	0	12	0.03	0	0	0	0	0
DAY_22	0	0	0	0	0	4.2	0.02	0	0	0	0	0
DAY_23	0	0	0	0	0	1.8	0	0	0	0	0	0
DAY_24	0	0	0	0	0	4.4	0	0	0	0	0	0
DAY_25	0	0	0	0	0	15	0	0	0	0	0	0
DAY_26	0	0	0	0	0	41	0	0	0	0	0	0
DAY_27	0	0	0	0	0	33	0	0	0	0	0	0
DAY_28	0	0	0	0	0	12	0	0	0	0	0	0
DAY_29	0	0	0	0	----	4.9	0	0	0	0	0	0
DAY_30	0	0	0	0	----	2.2	0	0	0	0	0	0
DAY_31	0	----	0	0	----	1.4	----	0	----	0	0	----
MONTH_TOT	0.01	0.00	0.00	0.00	0.00	293.01	3.43	0.00	0.00	0.00	0.00	0.00
MONTH_MEAN	0.00	0.00	0.00	0.00	0.00	9.45	0.11	0.00	0.00	0.00	0.00	0.00
MONTH_MAX	0.01	0.00	0.00	0.00	0.00	87.00	1.10	0.00	0.00	0.00	0.00	0.00
MONTH_MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: published data from USGS

ZACA CREEK NEAR BUELLTON
1992 Water Year (cfs)
USGS gage # 11129800, Discontinued in 1993

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
DAY_01	0	0	0	0	0.01	2.8	0.64	0.05	0	0	0	0
DAY_02	0	0	0	0	0	3.3	0.68	0.04	0	0	0	0
DAY_03	0	0	0	0.08	0.01	4	0.57	0.03	0	0	0	0
DAY_04	0	0	0	0	0	3.9	0.54	0.03	0	0	0	0
DAY_05	0	0	0	34	0	9.7	0.76	0.05	0	0	0	0
DAY_06	0	0	0	4.8	0.05	4.3	0.96	0.06	0	0	0	0
DAY_07	0	0	0	1.9	0.04	0.26	0.55	0.07	0	0	0	0
DAY_08	0	0	0	1.2	0	0.08	0.59	0.07	0	0	0	0
DAY_09	0	0	0	0.62	0.56	0.18	0.46	0.04	0	0	0	0
DAY_10	0	0	0	0.48	18	0.27	0.33	0	0	0	0	0
DAY_11	0	0	0	0.35	24	0.71	0.24	0	0	0	0	0
DAY_12	0	0	0	0.18	234	2.2	0.23	0.02	0	0	0	0
DAY_13	0	0	0	0.09	92	0.16	0.8	0.01	0	0	0	0
DAY_14	0	0	0	0.08	34	0.09	0.29	0	0	0	0	0
DAY_15	0	0	0	0.07	184	0.11	0.24	0.07	0	0	0	0
DAY_16	0	0	0	0.06	52	0.11	0.15	0.02	0	0	0	0
DAY_17	0	0	0	0.05	30	0.12	0.15	0	0	0	0	0
DAY_18	0	0	0	0.16	19	0.15	0.11	0	0	0	0	0
DAY_19	0	0	0	0.09	14	0.13	0.02	0	0	0	0	0
DAY_20	0	0	0	0.04	10	0.23	0.04	0	0	0	0	0
DAY_21	0	0	0	0.03	7.5	0.46	0.26	0	0	0	0	0
DAY_22	0	0	0	0.03	5.1	3.1	1.2	0	0	0	0	0
DAY_23	0	0	0	0.03	6.3	2.2	0.2	0	0	0	0	0
DAY_24	0	0	0	0.03	4.2	1.1	0.15	0	0	0	0	0
DAY_25	0	0	0	0.04	3.6	0.87	0.13	0	0	0	0	0
DAY_26	0	0	0	0.04	3.5	1.3	0.07	0	0	0	0	0
DAY_27	0	0	0.09	0.02	2	0.8	0.05	0	0	0	0	0
DAY_28	0	0	0.11	0.03	2.5	0.67	0.07	0	0	0	0	0
DAY_29	0	0	34	0.02	1.5	0.6	0.05	0	0	0	0	0
DAY_30	0	0	4.3	0	----	0.57	0.04	0	0	0	0	0
DAY_31	0	----	0.04	0.01	----	0.59	----	0	----	0	0	----
MONTH_TOT	0.00	0.00	38.54	44.53	747.87	45.06	10.57	0.56	0.00	0.00	0.00	0.00
MONTH_MEAN	0.00	0.00	1.24	1.44	25.79	1.45	0.35	0.02	0.00	0.00	0.00	0.00
MONTH_MAX	0.00	0.00	34.00	34.00	234.00	9.70	1.20	0.07	0.00	0.00	0.00	0.00
MONTH_MIN	0.00	0.00	0.00	0.00	0.00	0.08	0.02	0.00	0.00	0.00	0.00	0.00

Source: published data from USGS

Appendix C

Review Comments and Recommendations on the December 2, 1996 Draft Compilation and Synthesis Report

STATE OF CALIFORNIA—THE RESOURCES AGENCY PETE WILSON, Governor

DEPARTMENT OF FISH AND GAME
1416 NINTH STREET
P.O. BOX 944209
SACRAMENTO, CA 94244-2090
(916) 653-4875

January 16, 1997

Mr. Chuck Hanson
Hanson Environmental, Inc.
132 Cottage Lane
Walnut Creek, California 94595

Dear Mr. Hanson:

Comments on December 2, 1996 Revised Draft of Santa Ynez River Report

The Department of Fish and Game has reviewed the December 2, 1996 Revised Draft of Santa Ynez River Report. Previous Department comment letters were provided October 21, and November 18, 1996. Our comments on the December revised draft follow.

GENERAL COMMENTS

The Department strongly disagrees with two recommendations under Section 6.3, *Recommendations for Further Investigation*. These are to defer data collection and modeling efforts for habitat-flow relationships (page 6-28, last bullet) and temperature (page 6-33, second bullet). Modeling of habitat-flow relationships and temperature are identified as Jobs 3 and 5, respectively, in the long-term study plan which has been approved and incorporated into the 1996 Memorandum of Understanding as "Exhibit A." The Department believes efforts to resolve technical issues should commence immediately as opposed to deferring action until a later date, and recommends the Technical Advisory Committee (TAC) Study Coordinator proceed with scoping all jobs, activities, and procedures identified in the long-term-study plan, including jobs 3 and 4.

As stated in our November 18, 1996 comment letter, changes in the long-term study plan should only be made if an equal or improved alternative for information collection is included. As no substitutes have been proposed, use of modeling for both habitat-flow relationships and temperature must be included.

When access to private property to conduct Job 1 data collection activities was denied to Santa Ynez River TAC biologists in July of last year, the Biology Subcommittee determined that a more broad based, systematic approach to the access issue was necessary. The Subcommittee followed with a July 11, 1996 memorandum to the TAC which stated "Additional work is required in this area and without the inclusion of the Crawford section, it is doubtful that most of the objectives of the study plan can be adequately pursued." It was mutually decided by Subcommittee members that the "November report" would provide the format and approach for this effort.

Current efforts to secure access are limited to one sentence on page 6-12 which states discussions are "ongoing." Please describe the nature and extent of current and planned efforts to secure private property access for the purposes of implementing the long-term study plan . The Department recommends this section of the report be expanded to include an access plan which describes the level of current and planned effort dedicated to gaining access, including actions of the permittee to initiate a formal access negotiation process.

SPECIFIC COMMENTS

Page i
"...a series of ~~scientific~~ baseline data collection and monitoring studies has been ~~performed~~ initiated to provide..."

"The overall goal of ~~these studies has been~~ current and planned studies as to identify..."

Similar revisions were recommended in our October 21, 1996 comment letter. We believe it is important to make the distinction between existing *baseline* studies which are qualitative in nature, and those to be completed under the long-term study plan . Examples within the draft report which support emphasizing this distinction include the following statements:

- "There is a general lack of continuity within the temperature records from one year to the next as recorders were either lost and data could not be retrieved, or sampling at stations was discontinued as recorders were relocated from one location to another" (page 3-20).
- "Data gaps and failure of temperature monitoring instruments at a number of the locations resulted in incomplete temperature monitoring records" (page 3-134).
- "The fisheries surveys have been mostly qualitative in nature..." (page 5-1).
- "Habitat mapping within the tributaries has not been extensive, but rather has been based on periodic qualitative surveys" (page 6-4).
- "Habitat surveys conducted to date have provided an important foundation and valuable insights but have not yet been sufficiently extensive to meet the study objective and purpose" (page 6-16).

- "Although results of monitoring studies conducted to date have provided useful information regarding habitat conditions and fish occurrence within tributary areas, these studies have not provided a sufficient basis for evaluating the relative contribution of tributary and mainstem reaches for spawning and rearing. The data collected to date has been largely qualitative and descriptive" (page 6-35).

Page vi, first bullet
Is it possible to quantify the extent of the localized cool groundwater upwelling downstream of Bradbury Dam? The percentage of pools affected by upwelling? To what degree?

Page x, second bullet
What survey methodology was used?

Page x, third bullet
"Pool habitat exists even at low flow, but utility of pool habitats may be limited for coldwater species like rainbow trout/steelhead by lack of flow, elevated summer water temperature and low dissolved oxygen levels (Section 3)."

Page xiii, Recommendations for Further Investigations
"The long-term study plan for the Santa Ynez River fisheries investigation was developed and ~~implemented~~ adopted in 1996." (Plan jobs and activities have not yet been scoped out - we believe it would be misleading to refer to its status as "implemented").

"Based on the ~~scientific~~ baseline data that has been collected regarding various elements of these investigations..." (Same comment as page I above).

Page xxvii
"Management actions will be designed within the overall context of water availability and project operating constraints to maintain, protect, and improve habitat conditions for fisheries and public trust resources. The identification and evaluation of potential management actions would also be considered in context with the general guidelines for protection and enhancement of steelhead developed by CDFandG (McEwan and Jackson, 1996)."

Page 1-4 continued to 1-6
"The evaluation and exploration of the ~~feasibility of various~~ options...." "The ultimate objective of these analysis and deliberations will be to identify a range of ~~feasible~~ actions ~~which can be implemented within the constrains and limitations of the Santa Ynez River system~~ for presentation to the State Water Resources Control Board in hearings scheduled for the year 2000 " (The TAC emphasis should be on developing a wide range of management options, not on limiting options).

Page 2-18, fourth bullet
"...which has been managed primarily to ~~(1)~~ maintain and protect fisheries resources downstream of the dam, and ~~(2)~~ on a limited basis, to conduct specific..."

Page 3-78, second paragraph
Please qualify the statement "Surface and bottom water temperatures at mor downstream locations did not show a corresponding reduction in temperature, but rather at many Sites, water temperatures increased coincident with the arrival of waters from the WR 89-18 releases (Table 3-6)." The only sites where this appears to be the case is the Buellton and Cargasachi locations.

Section 4.0 Habitat Characteristics
Several terms are used in this section to describe what may or may not be the same procedure. They are "habitat mapping", "surveys", and "habitat observations" (page 4-1); and "habitat typed" (page 4-7). Please clarify if these terms refer to the same process.

Page 4-1, first paragraph
"The quantity and quality of physical habitat available within the Santa Ynez River and its tributaries play an important role in determining the potential of the river to support fish populations. Physical habitat consists of such flow-related parameters as the amount of space available, water depth, current velocity, substrate, availability of cover, water temperature, and water chemistry characteristics."

Page 4-14 tenth bullet
"Although IFIM is the methodology developed and accepted by the USFWS, and accepted by the DFG, the methodology ~~The IFIM method~~ has been criticized on a number of technical points and is not universally accepted by fisheries scientists."

Page 4-14, eleventh bullet
"Other factors may effect steelhead populations and will need to be considered when analyzing ~~negate~~ the effects of modeled variables."

Pages 5-35 and 5-44
The term "good condition" is used as a general descriptor of fish appearance. Because this term has legal implications under Fish and Game Code Section 5937, we suggest replacing with the actual observed characteristics such as color, lack of disease, behavior, etc.

Page 6-7, second full paragraph
This paragraph should state that the Department believes it necessary to collect temperature data and modeling as required by Job 4 of the long-term study plan.

Page 6-15, second paragraph
Line 2 - "...was developed and ~~implemented~~ adopted in 1996." (This is an important distinction as discussed under page xiii comments above).

Lines 7 and 8 - "Based on the ~~scientific~~ baseline data that has been collected regarding various elements of these investigations, recommended modifications to ~~future studies~~ the long-term study plan may involve..."

Line 11 - "...constraints exist for implementing ~~elements of~~ the long-term plan..." (This is a plan constraint which can effect all activities requiring data collection on the river and tributaries).

Line 15 - "...to be consistent with the 10 jobs descriptions ~~originally~~ currently contained in the study plan..."

Page 6-20, top incomplete paragraph
"The information can be used to guide PHABSIM modeling ~~if conducted in the future~~, (Job 3) or used independently..."

Page 6-29, second bullet
We submit that further temperature and dissolved oxygen work is required not only for pools providing rearing habitat for rainbow trout/steelhead, but also for all types of habitat within the mainstem. We disagree that observed water temperature data from one year (1996) creates the basis for what is stated as a "potential conflict"between increased releases from Bradbury dam and increased water temperatures as observed during 1996. We recommend that Job 4 data be collected throughout the long-term-study period, and conclusions formulated only after analysis of all information.

Page 6-31, second paragraph
Commensurate with our comments on page 1 of this letter, we do not agree with the statement that "The long-term study plan should be modified to defer any additional temperature modeling at this time."

Page 6-33, second bullet
Commensurate with our comments on page 1 of this letter, we do not agree that "Temperature modeling within the mainstem and tributaries is not recommended at this time for inclusion as part of the long-term study plan ."

Page 6-36, Job 6. Verification of Habitat-Flow Relationships
This section should clarify that the objective of Job 6 is to empirically verify modeled flow versus habitat relationships identified for target fish species/life stages under Job 3, and modeled temperature conditions under Job 4.

Page 6-37, third paragraph
It should be stated that determining whether rainbow trout/steelhead inhabiting the Santa Ynez River represent a resident or anadomous stock is not an over-riding issue to the Department as we believe that native resident and anadomous rainbow trout form a single interbreeding population in river systems where they coexist, thus management should be focused on restoration of habitat conditions that support all life histories that may be necessary to the long-term persistence of the population.

Page 6-39, Job 10: Identification and Evaluation of Potential Short- and Long- Term Management Actions
"Management actions will be designed within the overall context of water availability and project operating constraints to maintain, protect, and improve habitat conditions for fisheries and public trust resources. The identification and evaluation of potential management actions would also be considered in context with the general guidelines for protection and enhancement of steelhead developed by CDFandG (McEwan and Jackson 1996)."

The Department's recommendation is for the TAC Study Coordinator to rigorously pursue access negotiations, through the permittee, and with private landowners, and to move forward with all components of the long-term study plan , including the collection of habitat/flow and temperature data, as soon as possible. Long-term plan study results are necessary to produce the information necessary to develop flow and management recommendations for sustaining and restoring aquatic resources on the Santa Ynez River, including steelhead trout.

Please contact me at telephone (916) 653-4875 if you have any questions regarding this letter.

COPY ORIGINAL SIGNED BY JOHN L. TURNER

John Turner, Chief
Environmental Services Division

Attachment

cc: See next page.

cc: Trihey and Associates
Concord

Ms. Jean Baldrige
Ms. Ramona Swenson

Mr. Ed Ballard
U.S. Fish and Wildlife Service
Ventura

Mr. Jim Canaday
State Water Resources Control Board
Sacramento

Mr. Scott Engblom
City of Santa Barbara
Santa Barbara

Mr. Craig Fusaro
Santa Barbara

Mr. Marty Golden
National Marine Fisheries Service
Long Beach

Mr. Steve Mack
City of Santa Barbara
Santa Barbara

Mr. Ali Shahroody
Stetson Engineers
San Rafael

Mr. Bruce Wales
SYRWCD
Santa Ynez

bc: See next page.

MEMORANDUM

TO: Chuck Hanson (fax 510-937-4608 , phone 510-937-4606)

FROM: Ramona Swenson (510-689-8822, fax 510-689-8874)
Trihey & Associates, Inc.

DATE: January 17, 1997

RE: Comment on Santa Ynez Synthesis Report

PAGES: 1

Fish trapping locations
In Figure 5-1, the location of the mainstem trap is incorrect, according to Scott Engblom. See the attached map with approximate correct location.

Genetics
In Section 5.4 (Rainbow Trout/Steelhead Stock Origin), I have some additional information about the genetics. I spoke with Jennifer Nielsen about the sources of her genetic samples in the Santa Ynez basin, as cited in her Nielsen et al. 1994 paper. Of the 56 fish, 55 were from above Juncal Dam on U.S. Forest Service lands from Alder, Fox and Franklin Creeks. One fish was from Hilton Creek (mtDNA type 1). All fish were juveniles/YOY and 1+ fish. Please update Table 5-17.

Fish Distribution Tables
Tables 5-5 - 5-11 are still confusing. You need to define the blank versus shaded squares. Are the empty squares equal to zero fish observed during the snorkeling pass? Are the shaded areas indicative of no survey conducted? Yet you also have a "PV" for times of poor visibility and no survey. Does NR mean fish were present but not counted? Ask Scott!

cc: Jean Baldrige

4180 TREAT BOULEVARD - CONCORD, CA 94518
(510) 689-8822 - FAX (510) 689-8874
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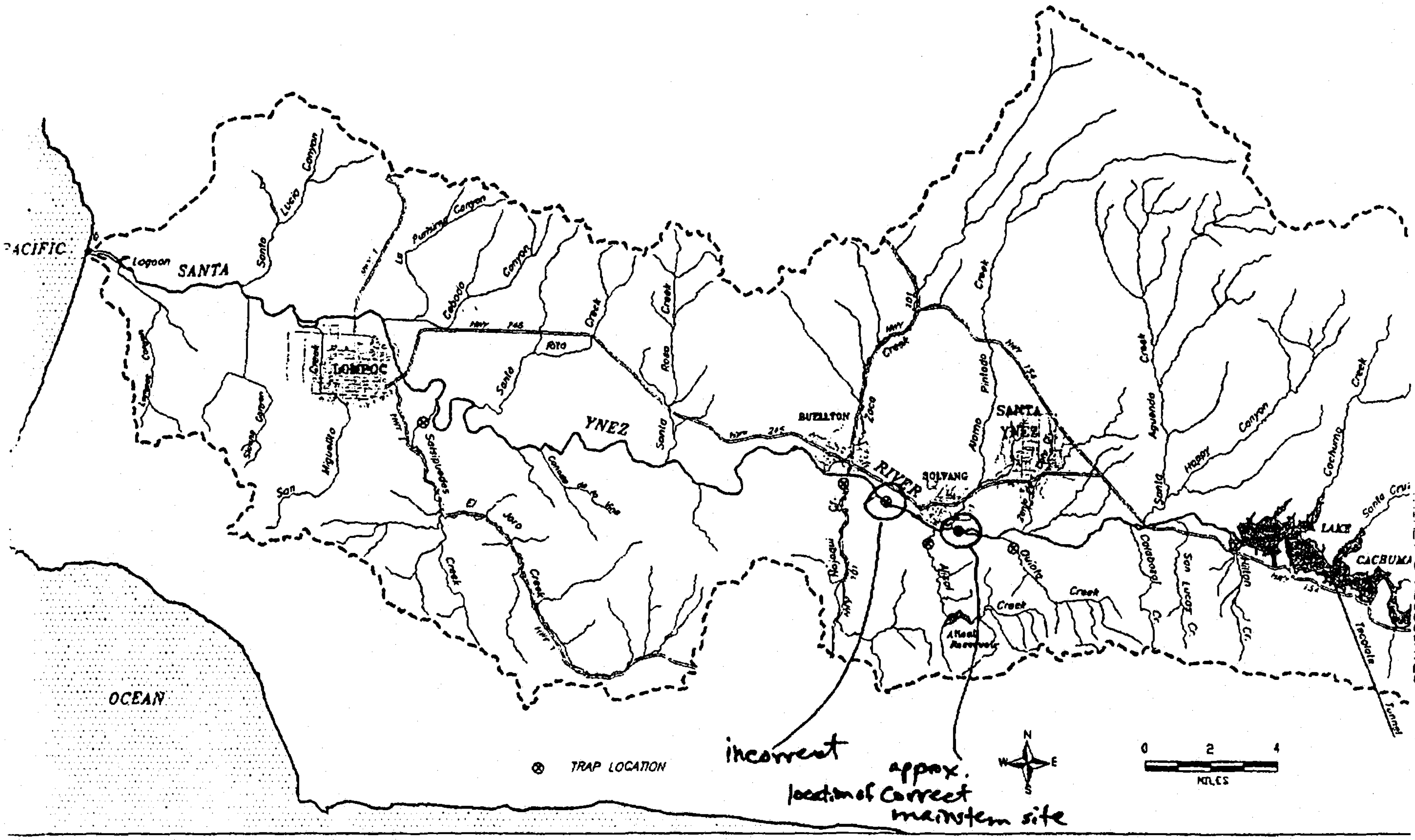

Figure 5-1.
Location of Fish Migration Traps on the Mainstem of Santa Ynez River and Tributaries

CALIFORNIA TROUT

KEEPER OF THE STREAMS

January 17, 1997

Mr. Chuck Hanson
Hanson Environmental, Inc.
132 Cottage Lane
Walnut Creek, CA 94595

RE: COMMENTS ON "SYNTHESIS AND ANALYSIS OF INFORMATION COLLECTED ON THE FISHERIES RESOURCES AND HABITAT CONDITIONS OF THE LOWER SANTA YNEZ RIVER: 1993-1996"

Dear Mr. Hanson:

Thank you for the opportunity to comment on this third and final revised draft report. You have done yeoman's work, as noted in the Technical Advisory Committee meeting in December. Thank you for your effort. The comments below are first of a more generalized nature, and proceed to more specific.

Generalized Comments

1. Temperature adaptations of southern ESU Santa Ynez River Steelhead/rainbow trout

It is clear from the list of figures and tables, as well as the body of text, that the overarching theme of this report is the story on temperature. One third of all tables, and two-thirds of all figures are about temperature, either by itself or in conjunction with other parameters of hydrology or water quality. Overall, one half of the combined total of tables and figures are about temperature. While it is certain that we need to understand the temperature regime found in the lower Santa Ynez River and its tributaries below Bradbury Dam, we need equally to understand the adaptations which biota that evolved in this system have made to the temperature regime in this current postglacial period. At only two points does the report point out that we cannot explain the existence and/or growth of steelhead/rainbow trout in oversummering habitat in the Santa Ynez River using temperature criteria available from the literature. Yet throughout the body of text, and in particular the section summaries and bulleted recommendations, this highly significant contradiction between prior knowledge and current facts is otherwise ignored, as if it had not been said at all. In a certain light, much ado has been made of the (presumed) deleterious temperature regime for Santa Ynez River steelhead/rainbow trout, when, in fact, we do not know whether the summer temperature regime so laboriously measured and described is actually beyond the range of adaptation for these seemingly unusual southern steelhead forms, described, in one section, to have nearly doubled in size in certain pool habitats precisely during these elevated summer temperatures.

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Given this anomalous and contradictory set of assumptions and facts, I would have expected the report to highlight this and call for investigation of the actual temperature tolerances of "southern ESU steelhead/rainbow trout." Yet I could find no such call for further information in that category, but numerous recommendations for further studies of almost all other types. I recommend that a bullet be added to the report, perhaps in Sec. 5.5, which makes such a call for refining our understanding of the temperature adaptations of southern ESU steelhead in the Santa Ynez River. Without such information, all attempts to reconcile literature-based assumptions on the subject (which have, to a study, relied on fish from more northerly watersheds) with the facts in southern California streams will, almost by definition, result in faulty conclusions. To be fair, in the report's initial discussion of steelhead/rainbow trout, possible differences in temperature adaptations by different populations was briefly noted, but then in the Summary (Sec. 5.5), bullet three lists a number of alternative mechanisms for reconciling the fact that these fish survived what was assumed to be detrimental conditions, without mentioning the possibility that they are so adapted. The second paragraph of Recommendations on Job 4 (page 6-29) would also have been an appropriate place to make such a call for better understanding of these temperature tolerances in southern ESU fish. As close as the report comes is embedded in the bulleted list of recommendations for Job 4, in the first bullet of page 6-34. However, this recommendation is to further study the literature on the physiology of temperature in rainbow trout/steelhead in the Santa Ynez River. There exists no such literature to study further. This is why I recommend, as above, that *de novo* studies of southern ESU, Santa Ynez River, steelhead/rainbow trout and their adaptations to warmer water be conducted. This will simultaneously provide further information needed to interpret use of Santa Ynez River habitat by steelhead/rainbow trout, aid in finalizing any proposed rule for listing under the ESA as initiated by the National Marine Fisheries Service (NMFS), and improve the likelihood that meaningful, defensible conclusions can be reached regarding the apparent anomaly of steelhead/rainbow trout survival and growth in water assumed to be too warm for such to occur.

2. Half a river

During our teleconference on the initial scoping outline for this report, I asked the assembled biologists at what point it would be prudent to tell the people paying the bill that from a biological science viewpoint, the MOU, TAC, and adjunct studies for the past several years have studied only half a river. The response was that it would be appropriate to discuss this in the "Potential Management Options" report currently slated for March, 1997. Throughout the present report, however, conclusions are phrased in such a way that if one does not remember the report's title continually (an easy memory lapse by the time one reaches page 6-32), we would be led inescapably to the fact that there really is only about 3 or 4 usable river miles of Santa Ynez River steelhead/rainbow trout habitat. This does the fisheries science of this report (and the fish) no justice. At some point in the present report, either more explicitly in the introduction, or somewhere in the conclusions, discussion, or recommendations for further study, it would be worth reiterating the context in which all of the study modifications, recommendations, and conclusions is set: the *lower* Santa Ynez River *only*. Tremendous opportunity for rearing steelhead/rainbow trout in useful, non-degraded, cooler, riparian-covered, graveled, watered habitat exists above Bradbury Dam and Lake Cachuma, and we owe it to the resource managers, water users, and the biological information base of the Santa Ynez River to point this out in the present report at some point. It should be clearly and explicitly spelled out both in the introduction and in the ending discussion, first to denote context, and finally to remind readers of this context as they try to assimilate all of the conclusions and recommendations of this voluminous report.

3. Anadromous vs. resident forms of steelhead/rainbow trout

Repeatedly the report (and these comments) has to resort to the cumbersome appelation "steelhead/rainbow trout" as if they were different species. Benke's (1992) excellent treatment of the native trout of Western North America makes one point very clear: *Oncorhyncus mykiss irideus* is a highly polymorphic, adaptable, plastic species, to be found in anadromous form, resident form, and in all gradations and mixtures of form in between. This polymorphic diversity of reproductive strategies is, in fact, how the species manages to persist in spite of all of the turbulent and broad environmental changes that have occurred in their coastal habitats during the current postglacial period. See the Department of Fish and Game's excellent summary of this issue in their comments to NMFS on the proposed listing rule for this species for a clear and thoughtful summary of this issue. As those comments indicate, this plasticity may be particularly important to the persistence of the southern ESU, where, closer to the edge of its contemporary range, flashy streamflows and large-scale anthropogenic changes in riparian corridors make it especially difficult for survival.

Thus, the continued referral to lack of evidence of anadromy except in Salsipuedes Creek is essentially moot. Any of these fish could go to sea given the opportunity, and any fish which may have spent time in the ocean could take up residency at whim. It is likely that individuals which are or could be anadromous interbreed with those which have remained resident. To wit, I have videotape of a small (10-12") male attempting courtship with a large (>22") female in Hilton Creek in early 1995.

It would be an improvement in the educational value of this report to readers if somewhere in the introduction to the biology of this fish, the broadly recognized plasticity of the species is noted as context for the continual references to anadromous or non-anadromous traits.

4. Beneficial effects of WR 89-18 releases during the summer

A section should be added to summarize the scattered observations about changes in the habitat of the Santa Ynez River below Bradbury Dam beyond the underscored (and intuitively anomalous) temperature increases far dowriver from the dam during the releases. While it is unclear that these temperature increases in fact produce adverse effects on oversummering trout, there is evidence that at least as far downstream as 10 miles (Alisal Reach) trout persisted, survived, and even grew nearly double in size during the oversummering period, a growth rate (while inferred) of the same order of magnitude as growth of trout in general in other streams of California during their first year.

The addional beneficial effects resulting from 89-18 releases which should be independently pointed out and underscored in a section of this report include the removal of accumulated algal mats which result from low flows after winter flow recession, and the elevation of minimum dissolved oxygen levels above 5.0 mg/l throughout all measured stations at all times during the 89-18 releases.

5. Use of lagoon as oversummering habitat

In a number of sections discussing lagoon characteristics, it is implied that the lagoon may be a good place to hold oversummering steelhead. It has water year round, and it is generally cooler at depth than other places in the river below Bradbury Dam except the first three or so miles below the Dam. These characteristics make it tempting to regard this as safe haven for young of the year steelhead. However, experience on the Carmel River with trap and truck operations of young of the year and/or smolts has led biologists there to caution regarding the placement of non-smolt young of the year in brackish water. They have experienced unexpected mortalities in this situation if the fish have not undergone actual smoltification and are not prepared to deal with the elevated salt concentration of the lagoon area (D. Detman, MPWCD, pers. comm.) Historic records indicate that at least some of the fish rescued from the Santa Ynez River middle reaches were put into the lagoon. Unfortunately, these same historical records do not indicate that any monitoring effort was undertaken to assess survivorship of those fish so handled. It would be ironic, indeed, to find that fish rescued and placed in the lagoon during those years died quickly of saline tissue desiccation in the brackish waters of the Santa Ynez River lagoon.

6. Writing style

I apologize in advance for my own cumbersome writing style, and for playing the "English teacher" with respect to this comment. However, I found sections of this report overly verbose and filled with technical jargon rather than plain English. Some of this is understandably necessary, as in the description of IFIM or PHABSIM. Much of it, however, actually gets in the way of understanding what is being said. It would be useful, especially in the executive summary and discussion of conclusions and recommendations, to make a point as plainly as possible without the use of technical jargon or redundant verbiage. As an example, I counted six uses of the word "overall" on page i. alone.

I do not suggest any rewrite of the present report. However, I do recommend that the draft "Potential Mangement Options" report due in March be written in a more succinct, plain-English style to promote, rather than hinder, understanding.

Specific Comments

Page i., last ¶. Discussion of long term study plan development suggests that the impetus was to provide a framework. My observations of the MOU process since 1993 lead me to believe that the principal impetus for the long-term study plan was the necessity to complement a longer period MOU, which was expressed as desirable to obviate the necessity of re-negotiating an annual MOU among the parties of interest.

Page ii-iii. Bullet 2 on page iii should be combined with Bullet 1 on page i. Same subject, same observation.

Page iii. Bullet 3. The observation that several creeks have (*had*) surface flow throughout the year should be modified to add the context: *during the three year study period*. It is unlikely that these creeks had perennial flow during the previous drought.

Page iii. last sentence. "The sandbar, is not, however, breached in every year." Would that we could say this with certainty, but, as your report notes (Sec. 2-6), there is no systematic data which has been collected or archived on the frequency of breaching. To so assert is, in fact, speculation. In point of fact, I asked one long-time observer of the river (previous manager of SYRWCD, ID#1) about this very item. His response was "I don't remember a year it didn't breach." Another longtime observer, now deceased, said he'd seen steelhead go over the sandbar on high waves in the winter. So we don't really have a good data set to draw conclusions about the effects of the sandbar or frequency of breach. Please refrain from such speculation.

Page iv., first bullet. "effect" vs. "affect." Please determine which is meant, and use accordingly throughout the report.

Also, this bullet is listed under a general heading "Hydrology", followed by the statement that conditions are "characterized by..." . This bullet (p. iv., #1) is not a characteristic, but a *conclusion* from observed characteristics. Please so denote or set apart opinions and conclusions from the other bullets, which are observed characteristics.

Water Quality

We need to add longitudinal sampling for nitrogen and phosphorus to determine the concentrations and sources of these plant nutrients, especially in light of the observations regarding the development of large algal mats under certain flow conditions in several years. Longitudinal distribution of N and P (and of the algal mats) may give us some indication as to the sources of enrichment leading to algal mat formation. Instream and bankside cattle defecation and urination have proven to be significant sources of plant nutrients in watersheds studied by the U.S. Forest Service in Oregon. Cattle will often preferentially stand in a creek if allowed access, to avoid painful ankle bites by certain flies (USFS, pers. comm.)

Page v., last bullet. "would be expected to result in physiological stress and/or mortality for rainbow trout/steelhead..." Please see the above general comment about temperature. This statement is the first of many perfused throughout this report which asserts such stress based upon assumptions gleaned from the literature on steelhead from such places as Northern California, Oregon, Washington, and even British Columbia. As noted above, the assertion of stress is directly contradictory to observations of survival and growth, even in the Alisal reach nearly 10 miles downriver from Bradbury Dam. Such apparent contradictions will never be reconciled as long as literature-based assumptions about thermal tolerance of British Columbia fish are applied to southern California steelhead.

Mainstem Dissolved Oxygen

first bullet. What are the sources of N and P for this "extensive algal production?" We need to find out.

last bullet. "River flow...by...89-19 releases was sufficient to remove much of the algae..." This beneficial effect of 89-18 flows should be emphasized here, and again later when it is discussed.

Tributary Water Temperature

first bullet. "Young of the year rainbow trout/steelhead were observed to be generally healthy and actively feeding at temperatures of up to 25.8°C..." And yet it is continually asserted that the incipient lethal maximum temperature for the species is 25°C. Futhermore, due to surface to volume effects, the smallest fish (those with the highest S/V ratios) should be the most affected by elevated temperatures. These fish clearly don't know they're dead! And these observations are more-or-less ignored throughout the remainder of the summary and conclusions bullets, as noted above.

As a footnote to this, and to point out the efficacy of watering Hilton Creek, I have both videotape and still transparencies of these same Y-O-Y fish dead and dried up on the rocks of Hilton Creek later that same year. They seem to be able to tolerate 25°+ water fine; no water is a different story for gill-breathers.

second bullet and following. Shute is later correctly spelled chute.

last bullet, p. x: Again, no reference to the possible temperature adaptations of southern ESU fish in the discussion of microhabitat selection (i.e., recognition of behavioral adaptations but none of potential physiological adaptations).

Habitat Characteristics

The first bullet does not describe what the results of habitat surveys have shown, but describes the nature of surveys. It is different than the subsequent bullets.

Second bullet; "pool habitats may be limited for *coldwater* species like ..." As long as the bias in thinking about these fish in terms of their more northern counterparts persists, we will continue to find unresolvable contradictions between theory and observation on the Santa Ynez River.

Fourth bullet: Again, the beneficial nature of 89-18 flows in scouring algal mats should be stressed or emphasized here.

last bullet, p. xi. discussion of passage barriers. From all I have gleaned from reading historic accounts, and talking to "old-timers" about migration timing, it is unlikely that much spawning migration occurs at low flows. It is likely, however, that some inmigrant spawners were (or still are) trapped in the river until the subsequent winter high flows, before outmigration.

Fishery Resources

third bullet (page xii). This is one of the several places in which this contradiction between theory and fact occurs, and one of the numerous places where a litany of behavioral and microhabitat hypotheses are given to account for the apparent contradiction. And in all of those numerous places, no mention is made of the alternative hypothesis that these fish may be physiologically adapted to warmer water than those of their more northern kin as reported in the literature.

page xii. third bullet. "Conditions during the spawning season have not been conducive to observation of spawning..." This is not true of the tributaries, in which spawning was observed in 1993 (L. Wolford, photographs and personal communications) and in 1995 (videotapes supplied to DFG and NMFS). Conditions are fine to observe tributary spawning, which reportedly occurs in most average to wet years in Hilton Creek (L. Wolford, personal communication). Further, the literature is replete with the observation that steelhead are prone to using tributaries more frequently than many of their congeners.

page xiii, first bullet. "Lower reaches of Hilton Creek do not provide viable rearing habitat... A potential passage barrier...may limit...access to the upper reaches of the stream." It should be clearly noted here that the upper reaches of Hilton Creek have not been examined by any biologist since the 40's. Reports exist of young of the year and larger second year trout in the spring-fed waters of the upper reaches above Bee Rock Quarry (L. Wolford, personal communication).

RECOMMENDATIONS FOR FURTHER INVESTIGATIONS

Job 1. Stream Reach and habitat inventory

page xiv. third line. "The stream reach and habitat inventory is a one-time, *basin-wide effort...*"

Here is one of the clearest indications of accidental myopia due to memory lapse both of the writer, and then, of necessity, the reader. To call an effort a basin-wide inventory when the report is titled "Synthesis...of...Fisheries..of the <u>Lower</u> Santa Ynez River" is a clear indication of the danger of not clearly spelling out and keeping in mind the limited scope of the present studies. This sentence should be modified to clearly reflect the limited scope of the MOU related studies.

page xv, second bullet, last sentence. This entire bullet is very difficult language to wade through, and its meaning is obscured by its syntax. Further, the third item in the terminal list is not a "condition" as specified by the lead-in clause, but a circular statement about habitat.

Job 3. Habitat-flow relationships...

page xviii, fifth bullet. "based on the best available scientific information;" <u>All</u> study elements require this. It is unclear why this feature is singled out here.

page xviii. last bullet. As noted above, factors affecting habitat suitability need to be taken in context with improved knowledge about the thermal tolerances of these fish, and not based on inferences from the literature about other watersheds. In a symposium section on IFIM studies at the most recent American Fisheries Society Cal-Neva Chapter meetings, it became clear that the portability of habitat suitability criteria is an issue of considerable debate. It is very important that we do not choose to define habitat suitability for fish in the Santa Ynez River through a filter of assumptions builit upon literature reporting the results of studies on fish in British Columbia or other points north of Cape San Martin.

page xix. "Release of water from Cachuma...appears to influence...fish distribution." Where in this report is the data which correlates water releases with changes in fish distribution? I missed it in my too-brief scan of the report. If it is there, it should be referred to in this bullet. If it is not, this part of this sentence is again, speculative at best, and such speculation should be kept to a minimum. While it might be intuitive to think that fish respond to flow changes by moving, it may prove that fish stay where there are or move irrespective of other-than-peak flows, under some conditions and at times.

page xx. fifth bullet. Delay of PHABSIM data collection. As discussed at the last TAC, this bullet needs revision to reflect the consensus of meaning that we should scope and resolve any remaining necessary work to clarify this element with all due haste, so that any future opportunities to further this element will not be missed. If that means dealing with the application of WUA confidence limits through bootstrap methods *sensu* Castleberry (1996), or developing reach-specific habitat suitability criteria, so be it. The phrase implying delay of this element does not forward the needs of the State Water Resources Board for decision-making on this river, and therefore, does not forward the interests of the MOU parties of interest.

seventh bullet. "...and the potential conflicts that may arise..." These conflicts may be an artifact of our limited understanding, once again, of the temperature adaptations of southern ESU fish. As a side-note to this thermal adaptation issue, I would note that it is precisely because these southern ESU fish may have this adaptation that it is so important to study and preserve what little genome remains. Given the future of all California's watersheds under most statewide population growth scenarios, and the potential for climate change on a larger scale, *warmwater* trout may be all we have to work with in the future.

Job 4. Temperature Modeling...

page xxii. first bullet. This activity should be correlated with algal mat abundance and antecedent nitrogen and phosphorus levels in the water.

page xxii. fourth bullet. As noted above, there is no literature on "...the physiological condition...of... rainbow trout/steelhead...inhabiting tthe Santa Ynez River..." What information is available from this literature has already been compiled in the Entrix (1995) Fish Resources Technical Report appended to the Cachuma Contract EIS/R. It is mute on the subject.

Job 7 Molecular genetics...

first ¶, last sentence. "SYRTAC is currently reviewing available analytical methods for appropriateness in addressing specific questions." I have attended all but one of the SRYTAC meetings since 1993. I am unaware of any agendized discussion of review of molecular genetics methods. To what review does this refer?

1.0 INTRODUCTION

Second paragraph: "...a series of baseline data collection and monitoring studies..." The MOU studies can hardly be described as baseline. In ecological/environmental texts and literature, the term baseline refers to studies done *prior to* any project or projected impact. Monitoring studies are then done post-project to track predicted changes or the effectiveness of mitigation measures. These MOU studies are decidedly post-project, so must be monitoring studies. Unfortunately, few baseline studies exist, and those that do (Shapovalov, 1944, '45) suggest that thousands to tens of thousands of steelhead used this stretch of river for migration, spawning or rearing in good water years.

page 1-3. There is an interesting order of presentation in describing studies and measures here, which usually reflects the thought processes of writers. Here, we see that non-flow measures (item 3) preceeds the discussion of alternative flow regimes (item 4). To the extent that this list of studies is indeed prioritized to suggest that we should examine first the diversity, abundance and condition of fishery resources, by extension it suggests that we should consider non-flow measures prior to alternative flow regimes, a position which has certainly been reflected in the stated interests of many water-resource related parties of interest in the MOU. I am not certain that all all parties of interest, however, share this *a priori* ordination of possible measures without the results of MOU and other studies in hand.

last two bullets. evaluation of feasibility of alternative actions. For the sake of consistency, both bullets should describe *proposed* management action, and the first bullet should read "...action has a *reasonable* probability of achieving..." as the second bullet reads "...can be *reasonably* implemented..."

page 1-4. Much of the writing on this page seems redundant to what has been already stated.

page 1-6. second ¶. line 3. "...summary of hydrologic conditions and reservoir operations on the Santa Ynez River..." Once again, accidental myopia creeps into factual errors. The present report does not contain a summary of reservoir operations on the Santa Ynez River, but a summary of operations of only one of the three dams on the River. Again, the focus on half a river has caused this lapse of memory. This should be rewritten to clarify that it includes only operations of Bradbury Dam.

Figure 2-3. It should be noted that these flows are conditioned by the operation of Gibralter and Juncal Dams.

Page 2-7. "Releases above 10-20 cfs have removed algae and improved dissolved oxygen concentrations." The beneficial effects of only moderate flows under the 89-18 release program should be underscored or highlighted somehow, either here, or in the management options report.

second ¶, last line. This sentence should be augmented to clarify that fish reserve account allocations have not been utilized between natural recession and the onset of 89-18 releases, a practice which might ameliorate some of the algal bloom conditions found by the onset of releases.

2.5 Tributary Flow - Salsipuedes Creek

It verges on the comic to characterize less than 1 cfs as important habitat-generating capacity for fish.

Page 2-13, first ¶. Why is Quiota Creek not mentioned in this list of tributaries which have some perennial sections?

2.6. Breaching of the Lagoon

As noted above, and as described in the last paragraph of this section, we do not have a consistent record of this characteristic. Much of the interannual variation in breaching is therefore speculative and should not be included in this data report beyond what has been observed between 1993-96.

Same comment for first bullet on page 2-19.

3.0 Water Quality Conditions

Second ¶, first two sentences. This is the clearest notation of the fact that we do not know the temperature tolerances of these fish. The report proceeds to ignore this statement to arrive at conclusions and recommendations for further study, as noted above.

3.2 Lake Cachuma Temperature ...

The meaning of the first paragraph in section is unclear. The report speaks of seasonal changes in water temperature, and of limnological conditions, with temperature and D.O. varying in response. What are limnological conditions, if not temperature and D.O.? Does the report here mean the depth location of the thermocline? Nutrient or sediment loads? The wording is confusing and perhaps circular in reasoning.

3.3 Santa Ynez River Mainstem Temperature

The first paragraph describes a lack of consistency and continuity within the temperature database. It should be noted that this lack of consistency is in spite of repeated calls at the TAC level for improved coordination of data collection. As the report notes, it will be important for interpreting future temperature and dissolved oxygen records that a relatively stable monitoring station grid be designed, reviewed, and agreed to by the TAC for all future monitoring. To the extent that nature has a hand in the necessity to change locations of monitoring devices, a certain amount of divergence is unavoidable. Monitoring stations should be chosen and installed in such a way as to anticipate areas of scour or sediment infill to mininimize such changes, however.

Figure 3-9 Water Temperature Monitoring Locations

Station 17 is not included on this depiction.

Table 3-4. Description of thermograph unit deployment location...

The data in the table describe the physical dimensions of the Spill Basin as 35' x 120'. This can't be correct.

Seasonal Trends in Water Temperature

Much has been made of Salsipuedes Creek as habitat for salmonids in this report. Yet in a previous section on flow, the upper reaches are characterized by flows less than 1 cfs, and in this section, the average daily summer temperatures and maximum daily temperatures are not different than the mainstem for the study reach below Jalama Bridge. It is unclear from these data why Salsipuedes Creek is considered such a great habitat for steelhead/rainbow trout.

Fig. 3-19, Long Pool Water Temperature records (lower panel)

Why is there such a big data gap (January to June, 1996) in temperature records of the "most significant fish habitat" of the Santa Ynez River, the "Long Pool?" Certainly it could not have taken 6 months to detect a failed or damaged recorder and replace it?

Alisal Reach

This section describes repeated, prolonged exceedances of various water temperature criteria which were selected based on assumptions gleaned from the literature on steelhead/rainbow trout from drainages to the north. The interesting feature of this temperature regime, when combined with data from a subsequent section on steelhead/rainbow trout mainstem persistence survival, and growth, is that these latter characteristics were observed in this reach, precisely where such prolonged, assumed-deleterious temperature conditions exist.

page 3-41, bottom of first paragraph. "These data suggest that daily variation in water flow at this location increases at increased flow rates." That is, the higher the flow rate, the more variable the flow rate is. What is the significance of this observation in a managed, highly variably release river? Isn't this observation self-evident?

Buellton, Weister Ranch, Cargasachi Ranch, Lagoon

Descriptions of data available, instrument movements or failures describe a rather helter-shelter situation for temperature records in these areas, making comparisons and systemic analysis nearly impossible. The recommended long-term temperature station array in later sections should ameliorate this disarray, but should be carefully reviewed by the project coordinator and TAC prior to final installation.

Analysis of Potentially Stressful Water Temperature

The majority of this section, including Figures 3-30 & 31, and Table 3-5, is moot as noted above, since inappropriate temperature criteria have been selected without reference to the proper temperature tolerances of southern ESU steelhead/rainbow trout. The discussion here is confounded by itself, and contradicted by observations of trout survival and growth in the Alisal Reach, 10 miles downriver from Bradbury Dam.

Page 3-69. Regression analysis. The "big conclusion" of this analysis is that the only trout habitat within the temperature range of trout is from 1-3 miles below the dam. In spite of, and not conditioned by, the fact that trout survival and growth was observed in the Alisal Reach, 10 miles below the dam. As noted above, this report-wide failure to reconcile theory and fact stems from faulty assumptions about the thermal tolerance of southern ESU fish gleaned from a reading of the literature on fish outside this region. As an editorial note, the actual conclusion reads "The results...are...consistent..in showing that average daily water temperatures during the summer months...is limited to..a 1-3 mile reach below Bradbury Dam." In other words, the river has no average daily water temperature below 3 miles from the Dam.

In the third paragraph, the report states "Results...suggest...that elevated water temperatures occur...a short distance downstream of Bradbury Dam, which may result in physiological stress, reduced growth rate, and reduced suitability...for rainbow trout/steelhead." And the converse is true: these conditions <u>may not</u> result in stress, reduced growth rate, and reduced suitability, if the actual thermal tolerances and range of adaptability of these southern ESU fish becomes fact rather than speculation.

Page 3-70. "Based on the...consistency of results and predictions...extensive additional effort to further refine these statistical relationships does not appear to be warranted at this time." I concur with this conclusion: we have done the best job we can at this point given the limited budget and personnel available to characterize the temperature regime of the river below the Dam, however spotty the record is. What we have not done, however, is understand the fish's response to this historically flashy and summer-warm river. More work needs to be done in this research area, as noted above, before anyone can claim to understand the Santa Ynez River Steelhead population.

Diel Fluctuations

The literature cited in this section regarding temperature tolerances of rainbow trout does not apply to this ESU, nor this river, as noted above. This section is the only place, however, in which the report acknowledges that "...there may be a geographic variation (e.g. clinal gradients) in the tolerance of a species to...water temperature...which may...increase the tolerance of rainbow trout/steelhead within the southern portion of their...distribution...to elevated...temperature." And concedes that "The biological significance of various water temperature conditions is difficult to interpret." I could not agree more with these statements, as is evident from comments above. The unfortunate aspect of the present report is that in most other sections, summaries, results, conclusions and recommendations, this caveat is ignored.

Cold Water Refuges

"The localized cool water areas serve as refuges from exposure to elevated temperatures (>25 C), and allow successful oversummering under adverse temperature conditions." Once again, the term "adverse" is applied without an understanding of the thermal tolerance range of this fish, and therefore is speculative. An analysis of the data from Table 3-5, however, shows that bottom temperatures exceed the presumed adverse temperature (25°C) in less than 4.5% of the observations, which may be part of the reason that this is not as large a survivorship factor as it is made out to be in the present report. Further, in another section of the report, as noted above, young of the year steelhead, most susceptible to physical/physiologic interactions of temperature due to their high surface to volume ratio, were observed to be actively feeding in water at 25.8°C in Hilton Creek.. It is difficult to understand, given these observations, why the report continues to persist in describing this temperature as "adverse" for this region.

Table 3-6. Water temperatures...at various locations

It should be noted from these data that at least down to mile 9.5 (Alisal 9), minimum water temperatures consistently cooled after 89-18 releases. The <u>average</u> water temperature would have been a useful statistic to track in this table, also, but is omitted from the Table.

Page 3-84. Temperature modeling results:

Another indication that at least the first 10 miles of the river below Bradbury Dam, and not the first three, may be useful steelhead rearing habitat, is result number 5 of the temperature model simulation analysis: "(5) average daily water temperatures at all locations and stream flows included in the simulation analysis were less than 24 C throughout the 9.9 mile reach between May and September." In general, however, I have little faith in models due to the normally limited number and inaccurate nature of assumptions used to build them.

Page 3-85. Another indication that the assumptions of models may not reflect reality is the assertion made in the first paragraph of this page, which describes the consistency between predictions of both statistical and simulation models and field observations. All of these are described to note that the best available habitat for trout is 1-3 miles below Bradbury Dam. This is not in dispute, and could have been guessed at by many trout biology practitioners without the modelling <u>or</u> field observations. What is inconsistent, however, about the models' predictions and the conclusions drawn from field observations, is the observed facts in the Alisal Reach, where trout persisted, survived, and apparently grew nearly double in size, about ten miles below the Dam.

Page 3-95, last ¶. "After 1996 WR 89-18...releases... At no time did dissolved oxygen concentrations decline below 7 mg/l..." This additional beneficial effect of the 89-18 release program should be underscored in the summary, as is the case for algal mat removal as a result of such releases.

Dissolved Oxygen in Response to River Flows

The results described in this section point out the beneficial effect of 89-18 flows on D.O. These, together with the observed effect that 89-18 flows have on removal of algal mats which are partly responsible for low D.O.'s, should be summarized in a separate section, or a summary bullet about river characteristics, or a conclusion section, or recommendation about river flow management.

3.5 Tributary Water Temperature
Hilton Creek-250 feet upstream of Santa Ynez River Confluence

Although this spot is where the fish trap was set in Hilton Creek, for purposes of temperature characterization, I do not believe that it is representative of the lower Hilton Creek reach below Highway 154. If I understand the location correctly, the reach is shallow, sometimes braided, and in an open, sunny stretch of creek not shaded by riparian cover nor enclosed in tall canyon walls like the remaining Hilton Creek reach below the "Plunge Pool." Some thought should be given to placing the lower Hilton Creek temperature recorder in a spot more characteristic of the pool and run habitat of this lower section.

Page 3-125, second ¶. "...surviving... juvenile rainbow trout/steelhead were...relocated...to the Spilling Basin..." This is a really bad idea, and worse practice. Any juvenile trout placed in the spilling basin become a wonderful food source for the numerous large bass and steelhead extant in the Stilling Basin. I recommend that this never be done again.

Page 3-130, last ¶, last sentence. This sentence needs to be highlighted in light of the interest the report has in focusing attention on Salsipuedes Creek. "The data available...is not...adequate to evaluate the effects of flow on inter-annual temperature differences."

3.6 Summary
Mainstem Water Temperature

A bullet needs to be added here which provides the caveat embedded in the text elsewhere, and which I have commented profusely on above: the temperature criteria chosen to evaluate exceedances may not be appropriate for this river or these trout. Bullets 6, 7, 8, 9, 11, and 12 all conflict with the evidence presented in the report, to the extent that they assume possibly inappropriate thermal tolerances for Santa Ynez River steelhead based on information from studies done on conspecifics further north, and to the extent that steelhead/rainbow trout 10 miles below Bradbury Dam nearly doubled in size under these "exceedances" and "adverse conditions" and that Hilton Creek young of the year were observed to be "generally healthy and actively feeding" at 25.8°C, above the "incipient lethal threshold." Bullet 12 is the only one which comes even close to recognizing this internal conflict between the inappropriate thermal tolerance limits chosen to apply here and the observed facts. Bullet 13 takes a stab at reconciling these differences by providing a mechanistic explanation of cool groundwater upwelling. While this physical feature is likely to play a role, the bullet (and all others) fail to provide any alternate hypotheses to explain this conflict, such as physiological temperature tolerance adaptations of southern California Steelhead to warmer water than their northern cousins.

Tributary Water Temperature

Hilton Creek

first bullet. Here is reported some of the data which should lead the authors to provide a number of alternate hypotheses regarding the thermal tolerances of southern ESU steelhead/rainbow trout (quoted in the comment immediately above). Given the higher surface to volume ratio of young of the year, one would expect this lifestage to be the least tolerant of approaching the lethal temperature maximum, yet here they were, generally healthy and actively feeding in 25.8°C. This is almost a blinking neon sign for observant biologists to indicate that something is "different" about these fish. Yet the report nearly fails to make the point, and only in passing in one paragraph.

El Jaro Creek

last bullet. Here is as close as a summary or conclusion bullet comes to making a recommendation that we need to better understand the relationship of temperature to fish health in this river system. Even here, the report focuses on microhabitats and behavioral selection thereof, without even mentioning the alternative hypothesis that fish physiology may play a role in explaining the discrepancy between survivorship theory (based inappropriately on more northern models) and direct observed fish survivorship in El Jaro Creek. Remember, this creek recorded the highest temperatures of any tributary monitored during the report study period.

Table 4-1 Habitat types

Are the units in this table feet or meters?

Page 4-4, first ¶. "The areal extent of pools decreased..." does this mean that each pool was smaller, or that the total area (in square feet) of pools per reach was smaller, or that the percentage of pool habitat in the reach decreased, as noted in following sentence? This language should be clarified. Further, this entire comparison of mesohabitat type suffers because the first reach (just below the Dam) is so much different in size than the remaining reaches being compared. Perhaps the units for comparison should be "proportion of [habitat type] *per mile*" of reach, so that habitat type <u>density</u> could be compared directly, not confounded by the large difference in size of the reaches being compared.

Figures 4-2 to 4-4 suffer the same problem noted immediately above. Thus, the range of pool habitat (15 to 25 acre feet) in the Hwy 154 reach is actually 60-100 AF/mile, since that reach was only 1/4 mile long. The same comparison for the Refugio reach then becomes only 0-2 AF/mile for pool habitat, and for Alisal Reach 0.5-1.17 AF/mile.

Instream Flow Modeling

The fifth bullet notes that the habitat suitability criteria of Bovee (1978) were used to calculate weighted usable area for the IFIM/PHABSIM work. Based on the most recent symposium talks by practitioners of habitat suitability estimation at the Cal-Neva Chapter Meetings of the American Fisheries Society (March, 1996), this practice is not currently accepted as valid. That is, habitat suitability criteria are not "portable" from one watershed to the next. Indeed, there was some indication from PG&E researchers that such criteria developed for a certain study in an upper reach of one river may not even work in a lower reach of the same river!

As noted by other commenters on earlier drafts of this report, the Entrix (1995) work needs reworking using information more specific to the Santa Ynez River. Included in the development of habitat suitability criteria should be an improved understanding of the temperature adaptations that southern ESU steelhead have made over the last post-glacial to flashy, summer-warm rivers in Southern California, and, in particular, to conditions in the Santa Ynez River (which conditions have been most likely exacerbated by the construction of the three dams).

All of the summary bullets in this section are therefore suspect.

The last bullet on page 4-14 suggests that the IFIM take into account the potential rearing habitat in the Santa Ynez River lagoon. As noted above, experience on the Carmel River with translocating non-smolted young to the lagoon indicates that a great deal of caution (and/or further study) is warranted before this procedure is contemplated seriously.

Riparian Vegetation

"In most areas, riparian vegetation in the Lower Santa Ynez River is not well developed." This statement seems to ignore the "war of the willows" conflict between farmers and conservationists in the lower river. Further, it describes conditions as we find them today, after three dams have taken the peak off flood flows, the extent of frequent lateral floodplain wetting, channelization, scour, and other hydrodynamic features of an unfettered river which tend to maintain riparian vegetation. It suggests also that these areas of the river are ripe for restoration and/or mitigation to promote healthy streambank vegetation which would result in bank stabilization, reduced bank erosion, better fish habitat, and an overall improvement in riparian health.

Substrate

¶ 2, line 2. "...spawning-sized gravels were of extremely limited availability..." It should be noted here that the diminution of gravel recruitment below impoundments is a well-established feature of constructed dams on rivers.

Passage Barriers

Even with the severely limited utility of such modelling and evaluation of passage barriers, the conclusion that a minimum flow of 25 cfs provides sufficient depth of flow to meet passage criteria is an argument in favor of a minimum flow during the possible fish passage months of 25 cfs.

4.4 Summary

The opinions contained in the second bullet again are predicated on the assumption that Santa Ynez River Steelhead is a "coldwater" species. The statements about temperature are not warranted unless and until more is known about these southern ESU fish.

Table 5-3. Some column headers have typos.

Table 5-10. Trout length estimates were made in the field using more size class increments than two (> or < 6") We should not be throwing away what little data exists on trout size classes by lumping as is done in Table 5-10 and noted by USFWS staff on previous drafts of this report and at the TAC.

1993-94 Spawning Season

Third ¶. "Adult steelhead...could have...remained in the river following spawning...but it is not likely. Adult steelhead which survive spawning typically return to the ocean shortly thereafter (Beeman, 1946)." This is an untenable presumption with no factual basis for the Santa Ynez River. Beeman discussed a perennial river system, much different than the "flashy" southern California streams, thus is in an inappropriate model to apply here. See also the comments of Mr. Ed Henke on the Cachuma Contract EIS/R and on the NMFS Proposed Rule to list west coast steelhead. His direct observations in the 1940's indicate that large, adult steelhead (spawners) frequently oversummered in Santa Cruz Creek headwater deep pool habitat, to return to the ocean in the peak flows *of the following winter*. He has indicated (personal communication) that it was difficult to get his fishing lure down to the level of the large fish because of the swarms of smaller fish above them in these deep pool habitats which would take the lure before it got down to the large ones.

In addition, among residents of Cachuma Village below Bradbury Dam it is common knowledge that a large number of very large fish (up to 2 feet in length and 10 pounds) were similarly trapped each year in the stilling basin after the construction of Bradbury Dam.

1994-95 Spawning Season and Table 5-12

In this discussion (beginning and p. 5-30 third ¶) and in the data table, conclusions are drawn about algal mats, dissolved oxygen reductions, and fish health. While in general it is to be presumed that low D.O. would minimize fish numbers, it is interesting to note that, as reported in Table 5-12, in the Refugio Reach the pool with the highest number of fish in August had the second highest algal mat cover, and in the Alisal Reach the pool with the highest fish density in August had the highest algal mat cover. It is clear that we do not know all we need to know about the relationship between algal cover and fish numbers, or of utilization of these algal mats by fish for cover from predation or use of contained food resources.

Page 5-30, second ¶. This is probably the most accurate and comprehensive conclusion or summary statement regarding the influence of temperature on summer survival of steelhead/rainbow trout to be found in the report.

5.2 Lagoon

It is interesting to note that the report suggests, in several places, that it may be possible to move fish to the lagoon. If the lagoon is a good place for steelhead/rainbowtrout, why are they not found there, as reported in this section and its associated **Table 5-14**.?

5.3 Tributaries
Salsipuedes and El Jaro Creeks
Upstream migration

In this section, data is presented on the condition of fish in Salsipuedes and El Jaro Creeks. Fish captured were in robust condition. In the section on the genetics of fish in various samples of the river, all of the fish in these two tributaries were listed as mtDNA type 5 or type 8 fish, noted in the text to be indicative of the southern end of the coastal geographic cline in these genetic markers, i.e., Southern Steelhead (see Table 5-17). Each fish captured had a "clubbed right pectoral fin." One conclusion to be drawn here is that southern steelhead could have imperfect or clubbed fins by the time they make their way upstream into the tributaries.

The last paragraph of page 5-49 makes the point that "Since rainbow trout/steelhead of hatchery origin often haved abraded or missing fins this information, in conjunction with genetic testing and other data may be useful in addressing issues of stock origin of Santa Ynez River fish." and refers the reader to Table 5-18 for a summary of observed fin conditions.

So on the one hand, it is noted that hatchery fish have less than perfect fins, and on the other, wild steelhead/rainbow trout of southern ESU genetic stock are reported with clubbed fins, and the report asserts that we are able to distinguish hatchery from wild stocks partly on the basis of fin condition. Perhaps this last assertion is not true. Wild fish often have a tough time in flows of the Santa Ynez River during some years which may peak, as in 1969, at over 60,000 cfs and carry rocks, trees, and other debris downstream directly against the upmigrating spawners, providing ample opportunity for fin abrasion. The use of fin condition to determine the stock origin of fish in the lower Santa Ynez River is suspect at best.

Hilton Creek

While the fish resources and trapping discussion of Salsipuedes Creek migrations was divided into upstream and downstream sections, and an analysis of Salsipuedes/El Jaro redds was made (Table 5-16) no such analysis was broken out for Hilton Creek. Considering that over three times as many fish were trapped in Hilton Creek, and that redds were marked with flags in Hilton Creek in February 1995, it is conspicuously inconsistent for the analysis to go into such detail concerning upstream/downstream and redd distribution in Salsipuedes/El Jaro and fail to do so for the data from Hilton. Why the inconsistency and omissions?

In the last paragraph (page 5-45) a discussion of 1995 young of the year observations is ensues. What is not mentioned, however, is that the Department of Fish and Game rescued several hundred of these young of the year in the late spring, when it became evident that the Bureau of Reclamation would once again do nothing to rewater the Creek as discussed at the TAC and suggested early in 1993 by the biological consultant to SYRWCD-ID#1. It is also likely that several hundred other y-o-y were rescued by residents of Cachuma Village (a longstanding practice of one river steward, now deceased). I have videotape and transparancies of y-o-y mortalities in June or July of 1995 along the dry rocks of Hilton Creekbed.

Table 5-17. Is it appropriate to include the samples of Nielsen et al, 1994 (first row of the data table) in this group, entitled "collected from the *lower* Santa Ynez River Basin" when, in fact, the Location listed is "Not Available?" In fact, I believe that all, if not some, of the fish in this group are from *well above* Bradbury Dam, possibly above Gibraltar and even Juncal Dams. Unless the location can be ascertained, this row of data should be excluded from Table 5-17 for purposes of accuracy.

One interesting feature of the data from Table 5-17 is that overall, 59 of 97 fish, or roughly 60% of the fish examined are of mtDNA type 5 or 8, described as associated with the southern end of the geographic cline in these genetic markers, i.e., 60% of the fish tested proved to be of southern steelhead origin. Even excluding the Salsipuedes/El Jaro Creeks samples, 36 of 74, or nearly 50% of the fish tested in the rest of the Santa Ynez River below Bradbury Dam are of the southern steelhead genetic stock. At least from the point of view of genetics, this is a significant proportion of the stock. This propensity for the Santa Ynez River steelhead/rainbow trout to be at least half from southern ESU stock is completely missed by the discussion in Section 5.4, in favor of the statement "...rainbow trout/steelhead inhabiting Salsipuedes and el Jaro creeks are most likely of southern California lineage." Why are the words "most likely" necessary when 23 of 23 fish sampled were of the southern genome? It would be more understandable if a statement was made to the effect that "at least half of the fish in the Santa Ynez River found outside Salsipuedes Creek" or "overall, 60% of the fish found in the Santa Ynez River below Bradbury Dam" are "most likely" of southern California lineage. But this statement is nowhere to be found in this discussion, in spite of the fact that the data support such a conclusion as much as they support the conclusion about Salsipuedes/El Jaro Creek steelhead/rainbow trout.

5.5 Summary

Again, in none of these bulleted summary points does the report mention the alternative hypothesis that physiological adaptations, as well as behavioral microhabitat selection, may account for the discrepancy between theoretical temperature limits and observed fish survival and growth in the lower Santa Ynez River.

Typo on p. 5-49. unresolved reference to "Table 5-?."

6.0 DISCUSSION AND RECOMMENDATIONS

6.1 Water Quality...

Page 6-3. Concern over the utility of IFIM/PHABSIM work done on the river to date has already been expressed. In my opinion, part of the concern has to do with the lack of habitat suitability criteria portability. These criteria, as noted above, are nearly reach-specific in a river, and the application of them from one river to another geographically far removed can no longer be supported by practitioners of the modelling. Also, as brought out in Castleberry, et al. (1996), significant improvements in the confidence one might place on the statistic "weighted usable area" or WUA, can be gained via bootstrap methods to place confidence limits on the statistic.

Page 6-6, second ¶. Once again, experience in the Carmel River argues for caution in asserting, a priori, that "conditions within the lagoon are generally more favorable for rearing rainbow trout/steelhead than areas further upstream,, and the importance of the lagoon habitat has been documented for populations of rainbow trout/steelhead in other central California coastal streams." (no reference given) It may be true that temperature and D.O. conditions are more favorable, but it remains unclear whether non-smolted young can long tolerate the salinity of brackish water, nor is it clear that the previous documentation for other central coast streams speaks to the issue of lagoon survivorship of nonsmolt young of the year.

And again, the conclusion reached at the end of the third paragraph is based on assumptions about thermal tolerance which are likely to be proven inapplicable to the southern ESU fish. And at the end of the fourth paragraph, the assertion of habitat conditions "more suitable" for steelhead/rainbow trout in the reach 1-3 miles below Bradbury Dam may be true, but is also at least partly belied by the fish survivorship/growth observations in the Alisal Reach, 10 miles downstream.

The wording of discussion of 89-18 releases in the second paragraph of page 6-9 is unclear. The second sentence reads "WR 89-18 releases...were formed to effectively remove accumulated algae...and improve...dissolved oxygen concentrations." These effects have certainly never been the reason for 89-18 releases. It would be useful to rewrite this section to clarify this apparent inconsistency. As noted above, a section, perhaps in this discussion here, would be useful to underscore the beneficial effects of the WR 89-18 releases.

Access to Private Lands

As I read this section, it occurred to me that a map showing the river course with the private land parcels marked out along it color or shade-coded to denote which ones we have gained access to and which not, would be very useful for decision makers and planners trying to address the issue of long-term study design under limited access conditions. Perhaps this section would be a useful place to include such a map.

6.3 Recommendations...

Generally, in this introductory section, there is no mention of available habitat and its use above Bradbury Dam (apropos of the report title). But as noted above, at some point it will become necessary for knowledgeable biologists to point out to those who have not had the advantage of that discipline that there is another half of the river which may be useful for further investigation in the event that any restoration or mitigation may eventually be required to address steelhead/rainbow trout. It does no good to ignore the issue at this point. It is in this introductory segment where I expected at least a <u>recognition</u> that there is a river above Bradbury Dam by the biologists. This would not be management recommendations, but a notation that looking at only half a watershed is unsupportable in the long run. It is like playing the piano with both hands tied behind the back, and sounds just about as good.

Job 1. Stream reach...

page 6-16, end of first paragraph, regarding opportunities for habitat improvements and enhancements, two comments are relevant. First, it is generally perfused throughout this report that the riverine habitat immediately below Bradbury Dam is the "best there is" below the Dam. If this is so, why the fuss about access to San Lucas Ranch. While it would be important from an IFIM/PHABSIM point of view, if it is in good condition, perhaps it needs no rehabilitation. Second, and adjunct to the first, in a recent trade association newsletter in Santa Barbara County, a guest editorial by one of the owners of the San Lucas Ranch noted that the family is proud of the stewardship results on the property over the last seventy years or so, and invited readers to visit the ranch to observe first hand the results of that stewardship. Perhaps the TAC could take advantage of that invitation, and lay to rest the issue of habitat suitability in that particular parcel.

Job 2. Habitat function...

Page 6-22, top. electrofishing. Elsewhere in the report it is noted that electrofishing methods are perhaps adverse to fish health, as has been noted from studies in Montana, Alaska, and elsewhere, and that such methods would be eliminated to minimize impacts to fish. Perhaps the calibration of snorkel surveys with electrofishing can be done elsewhere on non-wild fish (such as in the currently stocked reaches of the Santa Ynez River immediately above Lake Cachuma) so as not to risk damaging wild stocks.

Job 3. Habitat-flow relationships...

Third ¶. "Results of instream flow modeling need to be integrated with results of temperature modeling..." While this is true, I note again as above that IFIM work has been based on inappropriate habitat suitability criteria, and needs to be reworked using in situ criteria, and confidence limits on WUA developed, before integration of the IFIM and temperature models. The temperature models themselves need to be re-evaluated in terms of thermal tolerance criteria based on improved knowledge of the specific adaptations of southern ESU steelhead/rainbow trout to the temperature regime in which they have evolved.

Page 6-27, last bullet. The pool temperature changes associated with 89-18 releases did not seem to deter the steelhead/rainbow trout in the Alisal Reach, 10 miles downstream, from survival and growth.

Page 6-28, second bulletized recommendation. "...flow measurements made to determine minimum estimated flows for passage." Why is this information necessary? There is absolutely nothing which can be done to increase flows in the tributaries above that which nature provides.

Fifth bullet: Along with streamflow conditions, the condition of sandbar breach at the river mouth should be systematically recorded.

Sixth bullet: as noted by the Department of Fish and Game, this recommendation needs to be reworked to avoid the perception that any of the studies should be delayed. If further scoping and refinement of certain aspects of PHABSIM work need doing, this should be done with all due haste in order to avoid missing opportunities for habitat-flow information as happened in 1996.

Job 4. Temperature...

Page 6-30. The recommended array of temperature sites seems comprehensive enough. It should, however, be reviewed again by the project coordinator and TAC to make sure something has not been left out or misplaced. I again urge a closer look at the Lower Hilton Creek site to make sure that it is truly representative of the reach below the "Plunge Pool"

Page 6-31. third ¶. Once again, this discussion omits any reference to required information on the physiological adaptations of this southern ESU/strain of steelhead/rainbow trout. Without this information, any attempts to reconcile temperature models to observed facts of fish distribution, survival, and growth will fall short.

Page 6-33, second bullet. same comment as above.

Page 6-36. first bullet. Again, the deliberate movement of steelhead/rainbow trout should not be made without clarification of the role of the smolting process has on the survivability of young fish in brackish water, notwithstanding the literature. Once this ESU is listed under the ESA, mortalities resulting from premature movement into salt water would be considered a "taking."

Job 8. Coordination/Collaboration...

Fourth ¶. State Water Project water injection into the lower Santa Ynez River is fraught with biological problems. Two issues are paramount, and a third has surfaced in dealing with the first two. First, water temperature in the Coastal Branch Aqueduct in June, July, and August, is often above 25°C. Considering the fact the present reports documents insolation of 89-18 water released at about 17°C to above 25°C in the summer of 1996, starting with water at the higher point will certainly not improve the situation. Second, the trace mineral chemistry of water from the Feather River or San Francisco Bay/Delta is known to be significantly different in many respects from Santa Ynez River water. The homing behavior of steelhead is legendary, if imperfectly understood. The injection of differently "scented" water into the Lower Santa Ynez River may cause confusion in returning spawners and thereby reduce the population returning to the Santa Ynez. This, as well as mortalities due to elevated temperature, could be considered a "taking" under the ESA and will need further and serious consideration in the event the southern ESU is listed later this year.

In dealing with these issues, it has been suggested that one possible solution is to deliver 89-18 water directly from the State Water Project pipeline downriver at Lompoc. Two issues arise here. First, the politics of water in Lompoc have given rise to "common knowledge" that Lompoc would prefer not to take a "single molecule" of State Water, as they voted against the development of the State Water Coast Branch Aqueduct project. Second, redirecting 89-18 releases to a delivery point at Lompoc will eliminate all of the beneficial effects of these 89-18 releases noted in the report and above in these comments, including flushing summertime algal mats out of the system, greatly improving the dissolved oxygen concentration of river waters during the summer. The elimination of these beneficial effects is certainly a result that anyone concerned with maintaining fish in good condition below Bradbury Dam should be alarmed about. It is to be avoided.

This concludes my comments from the rather cursory reading I am afraid I have done on your excellent work. I hope these comments prove useful to make this a better final report, and look forward to seeing the final result. As always, if you have any questions or comments about any of the above, or need clarification of my poor writing skills, please do not hesitate to call (805) 963-8819 or write.

Sincerely,

Craig Fusaro

CRAIG FUSARO, PhD.
Central Coast Board Member

c: Mr. Marty Golden, NMFS
Mr. Ed Ballard, USFWS
Mr. Maurice Cardenez, CDFG
Mr. Dennis McEwan, CDFG
Mr. Bill Snider, CDFG
Mr. Paul Forsberg, CDFG
Mr. Jim Canaday, SWRCB/DWR
Mr. Carl Dealy, USBR

To: Chuck Hanson

From: Scott Engblom, January 15, 1997

Re: Comments on Draft #3 of the November Report

General Comments: I think you did a great job in incorporating all of the relevant comments.

Page 3-24 - Second paragraph: During the summer months of 1994, the temperature recorder was dewatered resulting in a discontinuity in the data set. I think it is important to include the results of this particular data set. Even though there is a period when the section was dewatered, there was continuity in the data set when water was present.

Page 3-57 - Table 3-5: Last two thermograph locations (Lompoc). I believe these thermographs are located in the upper portion of the lagoon, upstream of the 35th street bridge.

Page 3-63 - Cargasachi Reach: Only a bottom unit was deployed at this location, not a surface unit.

Page 3-71 - Last paragraph on the page: Surface and bottom thermographs were deployed in 1996 at miles 0.5, 7.9, 9.5, 15.0, and two locations within the lagoon; one set at Ocean Park and the other in the upper portions of the lagoon.

Page 3-78 - Water temperatures could be decreased several more degrees is water was released within the hypolimnion instead of the metalimnion.

Page 3-123 - Second paragraph, last sentence: Young of the year RBT/STL (not juvenile) were observed feeding on August 8.

Page 3-136 - Hilton Creek - Fifth sentence: Numerous yoy RBT/STL were observed to have died "prior to rescue operations."

Page 4-4 - First paragraph - second sentence: The survey found that the HWY 154 reach was dominated by three pools including one pool that accounted for 67 percent of the total reach length. Delete "and two smaller pools".

Page 4-4 - Seasonal and permanent pools: Pools, particularly deep pools, provide habitat for juvenile and older age classes of RBT/STL, and all age classes of LMB and Sunfish. Snorkel surveys have confirmed presence of yoy LMB and sunfish in reaches downstream of the HWY 154 reach.

Page 4-6 - Table 4-3: The source for the Hilton Creek habitat data is TAC 1995, not Entrix 1994.

Page 4-15 - Instream Vegetation - Second paragraph - second to last sentence: Differences in algal growth may be related to differences in water temperature, nutrient load, flow, and photo period. The Cargasachi reach probably had less sunlight in the morning hours due to the marine influence.

Page 4-24 - Directly above summary: The SYRTAC surveyed the lower 1000 feet of Hilton Creek in 1995, not 1996.

Page 4-24 - First bulleted item: Need better description of area surveyed (i.e., Fish Habitat in the SYR mainstem has been surveyed extensively in the section between the Highway 154 bridge (mile 3.4) and the Highway 101 bridge in Buellton (mile 13.6). In addition, a quarter mile section directly downstream of Bradbury Dam, and a 1.5 mile section near Lompoc has also been surveyed.)

Fifth bulleted item: Pools, particularly deep pools, provide habitat for juvenile and older age classes of RBT/STL, and all age classes of LMB and sunfish. Presence of yoy LMB has been confirmed in other reaches downstream of the HWY 154 reach during snorkel surveys.

Page 5-1 and 5-33: Conflict in reports of catfish fry observed in the mainstem and tributaries. The section on page 5-33 is correct.

Page 5-21 - Second to last paragraph: Need to mention that one amocyte was captured at this location indicating that lamprey migrate and can successfully spawn in the SYR.

Page 5-23 - Second paragraph - A total of 45 RBT/STL were seen in Unit 17 in August, one was seen in September, one was seen in October, and several were seen each of the following months. Several interpretations are possible but the information is insufficient to conclude that RBT/STL survived within the unit throughout the period.

I disagree with your conclusions regarding survival. RBT/STL were observed every month in this habitat unit although in smaller numbers than seen in August. The only conclusion that can be drawn is that RBT/STL did survive in this habitat unit (although their numbers were greatly reduced compared to the August observations).

Page 5-27 - Table 5-12: I still do not like this table format. I feel it misrepresents the amount of floating algae present at each particular habitat unit. Algae percentages began to decrease in October and November. This is not reflected in the table due to averaging the values for all months.

Page 5-31 - Third paragraph - Sixth sentence: Rainbow trout/steelhead seen in the mainstem could have been residents that held over winter there, or that may have migrated into the mainstem from tributaries.

Page 5-52 - First bulleted item: Bass fry were also observed in the long pool in 1996.

Page 6-4 - First complete paragraph - Last sentence "Although fish may migrate..." We have documented yoy and smaller size juvenile/adults oversummering in upper and lower Salsipuedes, El Jaro, and San Migueleto Creeks. The only tributary where yoy and adults have migrated back the mainstem is Hilton.

Page 6-10 - Access to private lands - second paragraph: areas where access is denied in tributaries includes Alisal, Quiota and the lower 1000 feet of Salsipuedes Creeks. The mainstem information is correct.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
Ventura Field Office
2493 Portola Road, Suite B
Ventura, California 93003

January 14, 1997

Mr. Chuck Hanson
Hanson Environmental, Inc.
132 Cottage Lane
Walnut Creek, California 94595

Subject: Final draft report titled, "Synthesis and Analysis of Information Collected on the Fisheries Resources and Habitat Conditions of the Lower Santa Ynez River: 1993-1996"

Dear Mr. Hanson:

The U.S. Fish and Wildlife Service (Service) has reviewed the final draft report, as submitted under your December 2, 1996 cover letter. The Service has reviewed two previous drafts of this report and are appreciative of how our comments have been incorporated. We offer the following comments on the revised draft report.

General Comments

1. The Service does not concur that the concerns raised regarding IFIM/PHABSIM are sufficient cause for further delaying the implementation of this job element. We believe that the concerns raised are invalid, have been met through the data collected in the studies already conducted, or are concerns that are typically scoped out in any IFIM/PHABSIM study. The only serious problem we perceive which might limit the success of this effort would be denied access to key areas of the river by private landowners. We also believe this to be true regarding the concerns given for delaying on further temperature modeling. Considering the inconsistency of temperature monitoring locations and methods for the last several years and the many data gaps, additional effort in refining the temperature model is needed. Both of these job elements, along with ground confirmation of flow through monitoring and flow verification (Job 6) are vital to evaluating the flows needed for maintenance of the fishery resources downstream of Bradbury Dam. To facilitate and ensure the completion of Jobs 3 and 4, specific methods and deadlines for dealing with the concerns and implementing both jobs should be provided in this report. We also recommend that access negotiations be rigorously pursued with the private landowners and that all components of the long term plan, including the collection of habitat/flow and temperature data, move forward as soon as possible. We would like to emphasize that the Service is committed to completing the

IFIM/PHABSIM studies and additional refinement of the temperature model. Without the completion of these jobs (and all of the other job elements in the long-term plan), we do not believe the goal of gathering the information needed to develop acceptable management alternatives can be achieved.

2. A more consistent discussion of the findings from the data should be provided for all reaches of the river where data was collected.

3. Meetings should be held as soon as possible among the biologists participating in these studies to determine the specific methodology needed to accomplish the recommended changes to data collection listed in this report. Also, a detailed schedule for the study elements should be developed and adhered to in order to provide consistency in the timing and frequency of data collection. We believe that detailed methods and schedules for each of the studies must be documented and made available to the biologists conducting this work to ensure consistent data collection.

4. The admitted discontinuities in the temperature data make it difficult to analyze the temperature trends during 1995 -1996 and interpret the results of the WR 89-18 releases. A well designed, systematic temperature monitoring program with frequent monitoring to prevent data gaps needs to be initiated. Based on the minimal and sometimes contradictory nature of the temperature data presented in this report, we believe it is premature to conclude that water temperatures increased after flows increased during the WR 89-18 releases. Furthermore, we are concerned that so much emphasis has been placed in these studies and in the analyses of pool habitats and so little on the value of higher gradient areas of the river (riffles and runs) for juvenile steelhead. The data indicates that there may be a few pool habitat units where cool water upwelling occurs. However, it is insinuated in several places in this report that this habitat is adequate, and actually degraded when flow is contiguous. We respectfully disagree. Juvenile steelhead are rheophilic, drift feeding organisms. They thrive in flowing water where they hold in the lee of instream cover next to feeding lanes which convey the aquatic invertebrates upon which they feed. This is their biology; not confined to a limited number of pools with limited food, space, many competitors, and centrarchid predators. A vast majority of aquatic invertebrates that serve as important food items for rainbow trout/steelhead are not only rheophilic but rheostenic as well (i.e., they must have flowing water). We believe that the benefits of increased available habitat of all types, decreased surface algae, increased dissolved oxygen levels and increased food supply provided by higher flows represent a considerable improvement in habitat for rainbow trout/steelhead that must also be taken into consideration along with the implications of present and future temperature data.

5. We have noted an apparent inverse relationship between stilling basin temperature and the released flow. When water is being released from the Fish Reserve Account, the waters contained within the stilling basin do not appear to be cooled significantly. The data presented in figures 3-3 through 3-5 indicate that summer release temperatures were approximately 15-16 °C, yet stilling basin temperatures were in the range of 19 °C.

Given the fact that the stilling basin serves as a small holding area for water that is completely exposed to the sun, it appears that the temperature benefits from the fish account releases are being minimized. It would seem essential, given what appears to be the capability of the Santa Ynez River to warm quickly, that adequate flows be provided or some engineering changes be considered and implemented that insure that the temperature of water leaving the stilling basin is at least close to the release temperature. The current plans by the Bureau of Reclamation are to pipe release water directly to the outlet of the stilling basin or into Hilton Creek during the dewatering of the stilling basin. This presents an important opportunity that should be taken advantage of to study the effects of alternative Fish Reserve Account release methods on downstream temperatures.

6. During July of 1996, the SYRTAC biologists were unable to conduct Job 1 data collection activities because of denied access to private property. In the July 11, 1996 memorandum that followed, the Biological Subcommittee stated that "Additional work is required in this area and without inclusion of the Crawford section, it is doubtful that most of the objectives of the study plan can be adequately pursued". It was mutually decided by the Subcommittee members that the "November Report" would provide the format and approach for addressing the access issue and its implications regarding implementation of the long-term study plan. Although access to private property is discussed in this report (section 6.2), very little detail about these efforts has been provided. Page 6-12 states that "Discussions are ongoing with private landowners in an effort to secure permission for access to habitat areas along both the mainstem Santa Ynez River and tributaries". Please describe the nature and extent of current and planned efforts to secure private property access for the purposes of implementing the long-term study plan. We recommend this section of the report be expanded to include an access plan which describes the level of current and planned effort dedicated to gaining access, including actions of the permittee to initiate a formal access negotiation process.

<u>Specific Comments</u>

Page I, Second Paragraph, First Sentence

Please change "a series of scientific data collection and monitoring studies has been performed" to "a series of baseline data collection and monitoring studies have been initiated". We believe that it is important to make distinction between the existing baseline studies which are qualitative in nature, and those that are to be completed under the long-term study plan.

Page x, Third Bullet, Second Sentence

Please change this sentence to read " Pool habitat exists even at low flow, but utility of pool habitats may be limited for coldwater species like rainbow trout/steelhead by <u>lack of flow</u>, elevated summer water temperature and low dissolved oxygen levels (Section 3)."

Page xi, Second Complete Paragraph, Next to Last Sentence

The Service and SYRTAC biologists have observed the passage barriers on Salsipuedes Creek (over 5 ft in height) and have agreed that these could be passable only during high flows. This sentence should make clear that the passage barriers were not judged to be insurmountable barriers only during high flows.

Page xi, Second Complete Paragraph, Last Sentence

As described in our comments on previous drafts, a concrete structure supporting a bridge creates a passage barrier over 5 feet high on El Jaro Creek that has been observed on several occasions by Service and SYRTAC biologists. Please report on this passage barrier.

Page xiii, Recommendations For Further Investigations, First Sentence

Please change this sentence to read "The long-term study plan for the Santa Ynez River fisheries investigation was developed and adopted in 1996." The long-term plan jobs and activities have not been completely scoped out. We believe that it would be misleading to refer to its status as "implemented".

Page xiii, Recommendations For Further Investigations, Fourth Sentence

Please change this sentence to read "Based on the baseline data that has been collected regarding various elements of these investigations..." (Same comment as page I above).

Page xvii - xix (Job 3)

See the first paragraph under "General Comments".

Page xxi, Fourth bullet

We recommend that the methods for collecting temperature and dissolved oxygen for each habitat unit be modified. These measurements should be made separately from the other habitat measurements for each reach. The collection of temperature and dissolved oxygen data for a select number of habitats within a short time period (e.g., 1 hour or less) for each reach will provide more comparable data. Coordination of this data collection so that it occurs within the same time period within several reaches will also allow more accurate comparisons between reaches.

Page 1-4, Bottom Paragraph, Last Sentence, Continuing to Page 1-6

Please change this sentence and the following sentence to: "The evaluation and exploration of various options..." and "The ultimate objective of these analysis and deliberations will be to identify a range of actions for presentation to the State Water Resources Control Board in hearings scheduled for the year 2000."

Page 2-7, Third Paragraph, Second Sentence

Please explain why the flows measured at the Solvang gauge are not considered as accurate as those measured at the Lompoc gauge. Both gauges are necessary to determine flow accretion or losses between the two locations which are separated by many river miles. Despite the stated lack of confidence in the Solvang gauge, flows recorded there are cited numerous times in the report. Does this imply that there is uncertainty in the data associated with the Solvang flows? Flows that have been taken by the SYRTAC and Service biologists on a frequent basis at established locations at various points from Bradbury Dam to Cargasachi Ranch during 1996 have received little mention in this report. Use of these data may provide more accurate measures of flow near Solvang. The water velocity data that was taken each month for each habitat unit (which are not mentioned at all) may provide more insight into habitat conditions and changes that occurred throughout the year in the various habitat units and reaches. Additional rated staff gauges or direct measurements will be necessary if mainstem water temperatures are to be further monitored at existing locations or in any new locations. These gauges or direct measurements should be placed at, or very near, the temperature monitoring locations. The summer months are the critical time period when water temperatures may pose problems for rainbow trout/steelhead on the Santa Ynez River. In retrospect, these months should have been extensively monitored in both 1995 and 1996, and for the remainder of the study, with site discharges directly measured or gauged.

Page 2-11, Second Complete Paragraph, Last Sentence

This sentence is partially incorrect. Alamo Pintado is intermittent in some places, going subterranean during the summer in its lower reaches. The Service and SYRTAC biologists have observed that in upper Alamo Pintado Creek, surface flows remain throughout the summer and fall.

Page 2-13, Top Paragraph, Last Sentence

Observations in the upper reaches of Hilton Creek (upstream of the shute pool and passage barrier) suggests that some water may remain throughout the year.

Page 3-19, Table 3-3

Lagoon Unit 1 in 1995 and 1996 was located at the head of the lagoon, near the inflow of the Santa Ynez River, not at mid-lagoon. The Service and SYRTAC biologists deployed the thermographs at locations 1 and 2 in 1995 (see page 8 of the 1995 Compilation Report). It appears that the surface and bottom thermographs for the upper lagoon have been confused for the middle and upper lagoon in the text and in figures 3-30 and 3-31.

Page 3-28, Figure 3-15

As mentioned in our comments on the previous draft, data collected by CDF&G in 1994 is missing from this graph. Please display the data presented for September 14 - December 14, 1994 in the 1994 Compilation Report (figure 8).

Page 3-41, Top Paragraph, Third Sentence

During August-October of 1995, there was a very thick layer of algae blanketing the surface of habitat unit 20, which may have created conditions inhospitable for rainbow trout/steelhead. Throughout the summer of 1996, very little surface algae was observed by the Service and SYRTAC biologists in habitat unit 20, coincident with the presence of rainbow trout/steelhead. The Service biologist also took temperature and dissolved oxygen measurements at the head of habitat unit 20 (a pool) during the summer of 1996 and observed cool temperatures and low dissolved oxygen values that indicated that subterranean water was upwelling from the interface between the upstream riffle and the pool.

Page 3-48, Top Paragraph

This paragraph and the following paragraph need to be corrected. No thermograph has ever been located at mid-lagoon. Thermographs have been located in 1995 and 1996 only at Ocean Park (47.1 miles downstream of Bradbury Dam) and at the head of the lagoon, about 200 yards downstream from the river mouth (mile 46.5). Please see page 8 of the 1995 Compilation report for further details.

Page 3-44, First, Third, and Last Paragraphs

The amount of detail presented for the average daily and maximum temperatures is considerably less than that presented on previous pages for the Hwy. 154, Refugio, and Alisal reaches. Please provide the level of detail for the Buellton, Cargasachi Ranch, and Lagoon locations matching that of the other locations. More consistent data reporting on all locations of the river where data has been collected is needed since these findings are only preliminary and there are still many unknowns concerning habitat conditions and rainbow trout/steelhead tolerances in the Santa Ynez River. This is particularly true since a recommendation in this report states that more information and more attention should be given in the future to the river downstream of Alisal reach.

Page 3-48, Second Paragraph

As mentioned in our comments on the previous draft, temperature data were also collected by the thermograph in the upper lagoon from 8/25/95 - 12/31/95 (See Appendix A of the 1995 Compilation Report). Please present and report on this data.

Page 3-51, First Complete Paragraph, First Sentence

Please change "Within the Spill Basin, average daily temperature.." to "Within the Spill Basin, average daily surface temperatures...".

Page 3-52, Table 3-5

The table heading ">25 °C" is missing under "Maximum Daily".

Page 3-57, Table 3-5

The August 1996 data has been presented for the Alisal Unit 45 Bottom thermograph but is missing for the surface thermograph. Please provide this data.

Page 3-57, Table 3-5

Please present the data from the thermograph located at the head of the lagoon, near the Santa Ynez River inflow for August - December 1995 (see page 29 and Appendix A of 1995 Compilation Report). The location has also been labeled incorrectly for the surface and bottom upper lagoon thermographs. Lompoc (35th Avenue Bridge) is in the middle of the lagoon and is the location where middle of the lagoon water quality measurements are made with the HYDROLAB. The upper lagoon thermographs are located about 0.3 mile upstream of the 35th Avenue bridge at mile 46.5.

Page 3-61, Top Paragraph

Please present a summary of the temperature data findings for Refugio Unit 17 for May - July 1996. It is appropriate that the findings be discussed for this unit since the thermograph for Alisal Unit 45 was operating for the same length of time (May-July 1996) and the findings for that unit are presented on page 3-61. A discussion of the findings for Refugio Unit 17 are particularly important considering the fact that maximum daily temperatures never exceeded 24 °C on the surface and average daily temperatures never exceeded 20 °C during May-July. Refugio Unit 17 was also the one habitat unit in the Refugio reach that held rainbow trout/steelhead in 1996. Furthermore, since the Refugio X Unit thermograph was not operating during June -July 1996, this data will provide more insight into conditions in this reach prior to the WR 89-18 releases.

Page 3-63, Bottom Paragraph

Please provide a discussion of the findings for the surface and bottom thermographs located in the upper lagoon (mile 46.5) for 1995 and 1996.

Page 3-64, Bottom Paragraph, Last Three Sentences Continuing to Next Page

When describing the specific changes in temperature that occurred between the different monitoring locations, please use the data that were collected using thermographs in 1995. Use of monthly daily averages for each location will allow a more accurate comparison of changes in water temperature between each monitoring site. This will ensure a more accurate comparison than the current presentation of single days from July- August of 1993 (which may not have been collected at the same time of day) that may not be representative for the entire month.

Page 3-67, Figure 3-34

As requested in our comments on both previous drafts, please provide information in the figure footer about what the data in this figure represents (daily average, max, etc.) This information has been provided in figures 3-32 and 3-33 and should be presented for this figure to make it clear to the reader what this data represents.

Page 3-68, Middle Paragraph, Eighth Sentence

Please provide a longitudinal gradient figure for 1996. This figure should be provided to allow comparison of the data for 1996 with data from other years that have been presented in figures.

Page 3-68, Middle Paragraph, Eighth Sentence

The statement that temperatures for the isolated pools were cooler in 1996 in many of the pools compared with 1995 is not supported by the data presented in table 3-5 or by any sort of rigorous analysis. Please delete this sentence. Review of the data for both 1995 and 1996 (table 3-5) shows that only one habitat unit (Alisal Unit 9) contained a thermograph in 1995 and 1996 in the Refugio and Alisal reaches where the isolated pools occurred for which temperatures can be compared. The other thermographs for the Refugio and Alisal reaches were either not operating during the summer of 1996 (Refugio X) or were deployed only for 1995 (Alisal Unit 48, Alisal Unit 20) or 1996 (Refugio Unit 17, Alisal Unit 45). Because of the different distances from the dam where these thermographs were located and the potential differences in habitat conditions (canopy, etc.) the temperature data for these thermographs cannot be reliably compared to determine differences between 1995 and 1996. In addition, your statement does not make it clear if the temperatures were cooler in these units throughout 1996 or only for the period prior to the WR 89-18 releases after which, according to this report, temperature stratification was lost and temperatures increased.

Page 3-70, Top Paragraph, Last Sentence

We do not concur with the suggestion that additional effort to refine the statistical analyses for evaluating water temperature conditions do not appear warranted at this time. Considering the inconsistency of monitoring locations and methods for the last several years and the many data gaps, additional effort is needed.

Page 3-72, Figure 3-35

Please provide the data in this figure for Alisal 45 bottom. Data was collected on the bottom of this unit before and after the start of the WR 89-18 releases. This data should be provided since it has been presented for the other habitat units where surface and bottom thermographs existed.

Page 3-78, First Complete Paragraph

As requested in our comments on the previous draft, a figure displaying the longitudinal temperature gradient just prior to the start of WR 89-18 releases is needed here for better comparison of the temperature changes. Please provide this figure and a description of the temperature changes between miles 0.5 to 24 just prior to the start of WR 89-18 releases. In addition, it appears that the statement in the first sentence that "Table 3-6 presents a summary of average daily temperatures at various monitoring locations" is incorrect. The data in table 3-6 appears to show the range of temperatures (minimum to maximum) that were collected, not average daily temperatures. For example, was there actually an average daily temperature of 17.0 °C during 7/20-8/9 at Alisal 45? The heading for table 3-6 should also specify what the data represents. A separate table that displays the actual average daily and average maximum temperatures for the time periods before and after the start of WR 89-18 releases for the applicable habitat units would be helpful for comparison.

Page 3-78, Second Complete Paragraph, Fourth Sentence

Comparison of data collected at Refugio X unit during 7/19/95-8/15/95 (see Appendix A, 1995 Compilation Report) with the same time period during 1996 as shown in table 3-6 (page 3-82) does not corroborate the statement that surface and bottom temperatures at more downstream locations did not show a corresponding reduction in temperature, and that, at many sites, water temperatures increased coincident with the arrival of waters from the WR 89-18 release. The water temperatures for the Refugio X site from 7/19/95-8/15/95 as shown in Appendix A of the 1995 Compilation Report show that temperatures during this entire period never fell below 20 °C and on several days maximized at over 26 °C. Review of the data presented in table 3-6 of the 1996 report for this same time period in 1996 show a temperature range that was considerably cooler, 15.9-24.2 °C. The thermograph at the X site during 1995 was located on the surface, while the thermograph in 1996 was located on the bottom, complicating a comparison. However, this report states that temperature stratification between surface and bottom was lost in pools as a result of the WR 89-18 flows. In addition, this report states that air temperatures in 1996 were warmer than in 1995. Taking into consideration these two factors, comparison of the data for 1995 and 1996 at the Refugio X unit (mile 3.4) suggests that temperatures were substantially cooler at this downstream habitat unit after the 1996 WR 89-18 releases were initiated.

Page 3-78, Third Complete Paragraph, First and Second Sentences

Please provide more specific data on the changes in temperatures between the Long Pool and Refugio mile 3.4 for the different flow releases to clarify what is meant by "rapid increase in temperature".

Page 3-86, Middle Paragraph, Fifth Sentence

Rainbow trout/steelhead also survived in Refugio X unit during September - October 1995.

Page 4-1, Fourth Complete Paragraph

Since descriptions are given of how much of the river was dry for 1994 and 1995, it should be mentioned here that for 1996, a half mile section of upper Refugio reach was dry by the end of April. The Refugio, Alisal, and Cargasachi Ranch reaches were largely dry by July prior to the start of the WR 89-18 releases, with the exception of a few pools.

Page 4-8, Third-Fifth Paragraphs (Continuing to Page 4-9)

Please provide more specific information about changes in habitat volume (percentages might be appropriate) between months for the different reaches. The description given for each reach currently is very general and is not particularly informative about the data presented in 4-2 - 4-4. An example of how the data might be presented would be: "Pool and run volume in the Alisal reach decreased by approximately 50% from July through September 1995.".

Page 4-12, Top Incomplete Paragraph, First Complete Sentence

This sentence is incorrect. Review of figure 4-4 shows that pool and run volumes were already smaller in June 1996 (approximately 2.25 and 2.15 Acre -Feet, respectively) compared with July 1995 (approximately 2.7 and 2.55 Acre-Feet, respectively). Please correct this sentence to show that pool and run volumes were at lower levels in the summer of 1996 (prior to the start of WR 89-18 releases) relative to summer of 1995.

Page 4-18, Top Paragraph

If the data is available, please provide a more detailed description of the changes in percent algal surface coverage that occurred during August - December of 1995. This information would be helpful relative to explaining the changes in dissolved oxygen and flow that occurred during that time. The SYRTAC and Service biologists noted that, during the fall, measurable flow increased somewhat, possibly due to less flow obstruction by the algae as well as decreased evapotranspiration. These increased flows were observable in the water velocity measurements taken in each habitat unit and in flow measurements made at various locations. We also recommend that a figure showing the algal coverage for spring or summer of 1996 be added.

Page 4-18, Fourth Paragraph, Last Sentence

The Service has reviewed the passage evaluation conducted by Entrix. We disagree with Entrix's conclusion that a minimum flow of 25 cfs would provide sufficient depth of flow to meet passage criteria for steelhead. Jeff Thomas, IFIM specialist from the Service's Sacramento Field Office, questioned the derivation of this flow because a separate passage investigation was not conducted during IFIM data collection used in the evaluation. Instead, existing riffle transects were used in the hydraulic model under the assumption that they would represent the most acute passage problems. These transects were not placed for this purpose and there is no assurance that the shallowest areas of the river were selected for their placement. In addition, the minimum passage depth criteria developed by Thompson (1972) that had been used had been arbitrarily altered from 0.6 feet to 0.5 feet. This was based on the assumption that adult southern steelhead are smaller and would require less depth, however this assumption was not defended.

Page 5-11, First Complete Paragraph, Last Sentence

The declines in sticklebacks may have also been primarily due to the significant drying and degradation of habitat that occurred in the Refugio and Alisal reaches prior to the start of the WR 89-18 releases.

Page 5-11, Third Complete Paragraph, Third Sentence

Numerous smallmouth bass nests have also been observed in the Long Pool in 1995 and 1996.

Page 5-16, Second Complete Paragraph, Last Sentence

Further review of the data for 1995 shows that the our comment on the previous draft was not completely accurate. Please change this sentence to show that by December 1995, many of the rainbow trout/steelhead observed were between 8-10 inches in length. By the time surveys began again in the summer of 1996, the rainbow trout/steelhead observed were in the 9-12 inch range.

Page 5-40, Last Paragraph

Snorkeling surveys of Nojoqui Creek were conducted by the SYRTAC and Service biologists during the summer of 1995 and 1996. Please report on the results of these surveys.

Page 6-18, Last Bullet

Mapping of percent coverage by algae should also be conducted for the different habitats under various flow conditions.

Page 6-29, Second Bullet

We do not agree with the way this bullet is stated and ask that it be changed. We believe that efforts should be coordinated as part of the fish reserve account releases and WR 89-18 releases to further evaluate the effects of surface flow on water temperature, dissolved oxygen and other parameters in all types of habitat within the mainstem river. We do not believe that the 1996 data are adequate to show that potential conflicts arise between increased instream flow releases and increased water temperatures. To the contrary, the increased amount of habitat of all types available to the rainbow trout/steelhead, the decrease in surface algae, and improved levels of dissolved oxygen that occurred following the start of the 1996 WR 89-18 releases documented in this report compared to the few, isolated pools (and even fewer pools where upwelling was observed) that existed prior to the start of the releases suggest a substantial improvement in overall habitat conditions for rainbow trout/steelhead and the other fish species. That a temperature increase following the start of WR 89-18 releases occurred is not fully substantiated by the data presented in this report and there appears to be data for some units (such as Refugio X) that contradicts this (see comment on page 3-78). As mentioned in this report, rainbow trout/steelhead continued to persist in the habitat units throughout the WR 89-18 releases where they had been observed prior to the releases. Furthermore, during the 1996 WR 89-18 releases the SYRTAC and Service biologists observed abundant growth of many species of aquatic plants and an abundance of macroinvertebrates inhabiting this aquatic vegetation. In 1995, very little aquatic vegetation other than filamentous algae was observed, when thick blankets of algae covered the surface of most of the isolated habitat units. Whether or not somewhat cooler conditions prevail in a few isolated pools, a few isolated pools should not be misconstrued as representing acceptable, preferable habitat for sustaining a thriving, viable rainbow trout/steelhead population.

Page 6-30, List of Thermograph Core Locations

We recommend that a core thermograph also be located intermediate between Refugio X (mile 3.4) and Alisal Unit 48 (mile 7.8). A thermograph in this location will help provide a clearer definition of how temperature changes with distance from the dam, particularly important in this section of the river closer to where water is released. We also agree that thermographs should be downloaded on a monthly basis to minimize the loss of data.

Page 6-32, Top Paragraph

Placement of several instruments continuously collecting dissolved oxygen data (e.g, HYDROLABS) at several locations may facilitate gathering data that are more comparable. Rotation of several of these instruments among a number of habitat units in each of the reaches within a limited time period would allow collection of data that could be compared between habitat units and reaches. We also recommend that other data about other factors affecting habitat conditions be collected on a consistent, regular basis, including percent algal cover, percent canopy and water flow.

Thank you for the opportunity to review and comment on the final draft report. If you have any questions, please contact Ed Ballard of my staff at (805) 644-1766.

Sincerely,

Diane K. Noda

Diane K. Noda
Field Supervisor

cc:
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